The Electrical World.

VOL. XXX. NEW YORK, SEPTEMBER 4, 1897. No. 10.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

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THE ELECTRICAL WORLD,

253 Broadway, New York.

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LONG-DISTANCE ELECTRIC TRACTION.

The great impetus which was given to the electrical industries by the invention of the dynamo machine, making possible electric lighting, was succeeded by that due to the advent of the electric railway. For ten years this has held the field as the most important application of electric power, and has slowly developed and evolved from its crude beginnings to its present perfection. The great problem which now confronts electrical engineers is the operation of the present steam railroads, or other railroads for long-distance and heavy service. There can be no question that the solution of this is to be made in the immediate future, and that the electric arts will find their most profitable and largest application in this great field of work.

The methods to be adopted for the electrical propulsion of trains on the present steam railroads seem to divide themselves naturally into two classes, depending upon the use of direct or alternating current. The possibilities of the direct-current system seem to be immediately limited by the high potentials necessary for the successful transmission of large powers to long distances, and also by the limitations of direct-current machinery operated at high potentials. It is not likely that large motors would be found perfectly reliable under pressures greater than 1000 volts, and even at this rather moderate potential the difficulties with commutators and insulation would become grave. Under the circumstances it seems that the alternating current in some of its forms must be looked to for the solution of the traction problem.

Considering the alternating-current system of supply, there seem to be several combinations possible which would prove at least worthy of trial, for example, the use of rotary transformers furnishing direct current at a reasonable voltage for the line. The mounting of these rotary transformers directly upon the train, and distributing the alternating current at moderate pressures by a trolley system, seems also a reasonable solution. It is, however, to the use of induction motors that we can look for the most promising developments.

In any system the working voltage must be limited by considerations of safety and easy insulation. Since, however, it is likely that the potential sent out from the power stations for long-distance service would of necessity be very high, the transformer would be a needed part of any such railway system. The question, therefore, becomes one of how to use the moderate potential alternating current for the propulsion of trains, this current being supplied to sections of the tracks and conducting systems by means of properly located transformer stations.

The rotary transformer is a machine of high efficiency and of such simplicity that its use will probably lead to no great difficulties. With a direct current system of supply, through their agency, to the track sections the difficulties will probably be centered in the motors on the cars, these having of necessity the troublesome commutator which has been so long a source of difficulty in electric-railway work. With the induction motor this difficulty vanishes, but it is yet to be shown how these motors can be properly controlled for railway work. Viewing the whole question from the standpoint of present knowledge, it seems likely that the rotary converter and the direct-current motor on the train offer the easiest and most feasible present application of electric power for this purpose.

The methods of conduction would naturally be very different from those in use for street railways. The area of contact between the trolley wheel and wire is entirely too small to permit the passage of the heavy currents which would occur in this variety of work. A more substantial conducting system would probably be necessary and, with modern methods of bonding, this could possibly best be secured by the use of rolled steel in some form. Given a suitable system of track conductor, solidly installed, there should be no difficulty in the operation of very heavy trains upon it. The recent experiments at Hartford have exhibited the conducting qualities of a rather crude system of third-rail installation. With this third rail properly elevated above the ground and guarded in some way so that it would not prove dangerous to workmen and others upon the tracks there should be no great difficulty in the successful operation of such a system. The only obstacle that appears to present any special difficulty is the grade crossing, at which, of necessity, the third rail or other conductor must be omitted. When it is considered, however, that the best class of steam railways are rapidly doing away with all grade crossings, and making their rights of way more inaccessible to trespassers, it will be seen that this is probably not a difficult matter after all.

That the railroads would gain by such a change of motive power almost goes without saying. This gain would be twofold. First, in the possibilities of greater speeds, and second, in the cheapening of motive power on roads where many trains are operated. The steam locomotive is a highly efficient piece of apparatus when its limitations are considered. It is doubtful whether, with the best engines burning the same coal that is used by locomotives and transmitting power electrically to one or two moving trains making many stops, the power could be delivered upon the axle of the train at any less cost than with the locomotive. When the number of trains increases, however, and the demand for power becomes more continuous and steady, the advantages of the electric system become immediately apparent. Another point of the greatest importance is that these power houses may be located in districts where fuel is cheap and where natural water-powers can be utilized. It is not too much to think that before many years Niagara will furnish power to the railroads in its neighborhood over a radius of many miles. As to speeds, the smoother running of the motor, the absence of reciprocation, the rapid acceleration possible, all combine to render speeds certainly 50 per cent. in excess of those now attained by steam trains an easy possibility.

It behooves the electricians to be up and stirring. The greatest field that they have ever had for the exercise of their talents and ingenuity is before them. The time for the equipment of the steam railroad is nearly at hand and cannot be long delayed.

THE ELECTRIC AUTOMOBILE.

A new and growing field is opened for electricity in the design and construction of electric automobile vehicles. There has been great progress in this direction for the last few years, the progress having kept step with the improvements in the storage batteries. This, however, has not been as rapid as many had hoped it would be. There seems to be a growing demand for these vehicles for two distinct varieties of use. As pleasure carriages they probably have no superiors, and to take the places of stages, delivery wagons, and other vehicles, which are in steady and regular use, they seem to be well adapted. So far there has been no great differences in the types of these automobiles, as, indeed, there cannot be, seeing that they all consist essentially of a storage battery and a motor geared to the wheels of a carriage. The problems involved in their construction are nearly all mechanical, and many very beautiful and ingenious solutions of these have been brought forward, as is notably the case in the type of vehicle illustrated elsewhere in this issue.

It is likely that the growing popularity of these carriages will have a strong effect upon the development of the storage battery. They demand for their proper operation a light and powerful battery which will not be damaged by the jarring of the vehicle and which will not depreciate very rapidly under ordinary use. There is much room for improvement in the storage battery as at present manufactured, but it has generally been observed that wherever a strong demand for an improvement or invention exists it is soon supplied. It is, therefore, to be hoped that before long a type of battery more perfectly adapted to this purpose than any which has yet appeared will be available.

Another effect which the use of such motor vehicles will produce is the betterment of streets and roads. It is claimed in some quarters that we are upon the threshold of what is known as "the horseless age," but, whether or not this be true, there is no doubt about the wonderful effect which a larger use of motor-propelled carriages would have upon the condition of the roads and thoroughfares of the country.

The possible improvements in these vehicles seem to be limited to details and to the battery. The majority of those at present in operation have a rather limited range of action, not being able to go more than 20 or 30 miles on one charge of the battery. There is room or much improvement in this direction, the utility of the vehicle depending, to a considerable extent, upon its range of action away from the charging station. Higher efficiency in the batteries will, of course, improve the range of action. The other possible betterments of the automobile are of necessity confined to details, its general scheme of operation being probably the best that can be devised. There seems to be little doubt that the steam, gas and gasoline-driven carriages will not be able to compete with the electric vehicle in the future, seeing that all the advantages of cleanliness, convenience and safety are on the side of the latter. While this application of electricity is quite limited, there seem to be large possibilities for the electric automobile, and its advent should be hailed with satisfaction by all who are interested in the progress of the electric arts.

CONCERNING TELEPHONES.

The present telephone situation in this country presents a very attractive field for speculation, seeing that it is almost impossible to predict with any degree of accuracy what its outcome will be or what aspect the future of telephony may take. The independent companies seem to be growing in strength and importance and are rapidly building their network of wires over a large part of the country. Invention, which has been slow in many departments of telephony, has been wonderfully stimulated by the appearance of these companies and already a distinct and noticeable betterment of telephone service can be observed in almost all of our cities. It will be remembered that when the telephone first began to attract public attention there was much comment in the press about this mysterious and wonderful invention, and that elaborate predictions were made as to its future possibilities. Many of these predictions were, of course, ridiculous, but many others have been realized.

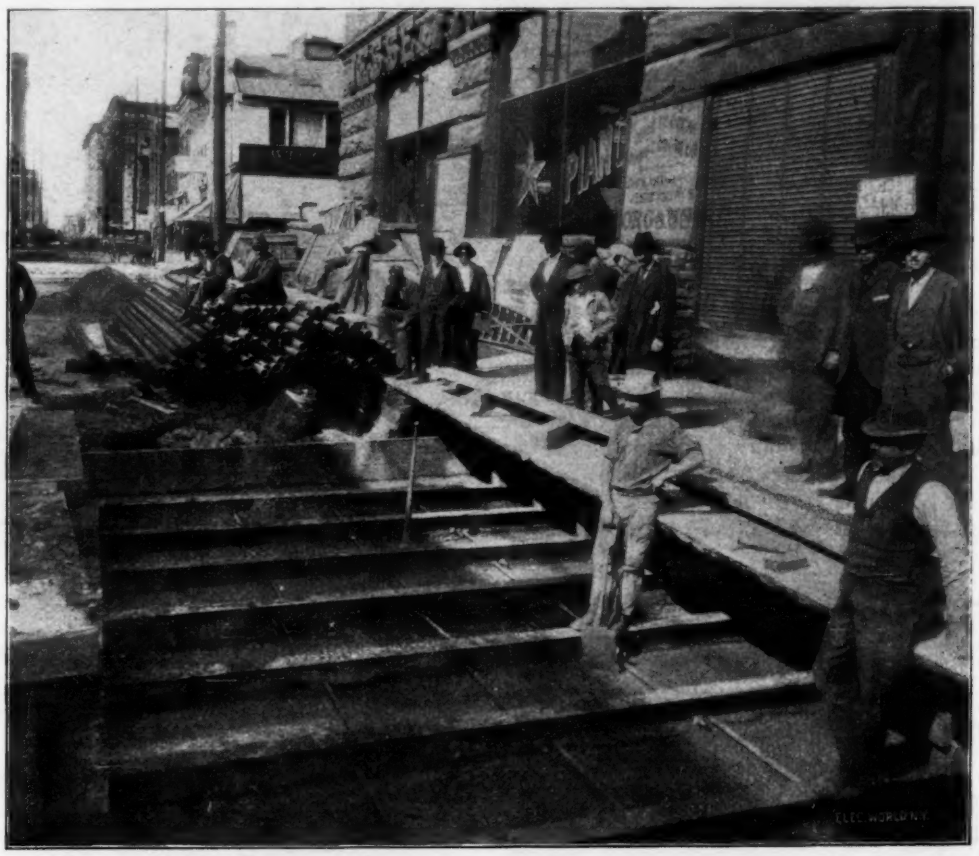
The fascinating problem of ocean telephony, that is, telephony from continent to continent through cables, remains yet without a solution. It presents one of the most difficult and at the same time most delightful fields for study open to the telephone engineer. It does not differ in one respect, however, from many other alluring fields of invention, in that it is probable that certain financial conditions will limit the successful application of such an invention even should it be forthcoming. Probably the most needed invention in the whole art of telephony at this time is the telephone repeater, and many have predicted that when this has been satisfactorily made the problem of ocean telephony will be solved.

Conduit Construction in St. Louis—III.

BY FRANK CLARK COSBY.

The Bell Telephone Company of Missouri, at present the only local telephone company in operation here, has always borne in mind the advantages and possibility of placing its wires underground, which is shown by the fact that when it selected the corner of Tenth and Olive Streets as the site of its telephone building, the building was erected with a view to having an underground service—an arch being made in the walls and space being left in the cellar for the entrance of the ducts, and a cable shaft built from the basement to the sixth floor, where the exchange was to be located.

The general plan upon which its system is laid out is as follows: There are three main trunks or backbones—on Tenth Street east and west, on Olive, from Twenty-sixth to the river, and on Fourth, east and west, in the underground district—and from these trunks the mains branch out, east and west, and north and south, as the case may be, the secondaries or distributing lines coming off these mains. In the busy district east of Twelfth Street to the river, these mains run to manholes at the entrances to the alleys and from these manholes up the alleys through secondary distributing ducts to a manhole in the centre of the block, the necessary number of wires being tapped off through underground laterals to to the buildings they are required to feed. These laterals may take either a single circuit for one telephone or a cable of any number of circuits for all the telephones in an office building. In the less busy district west of Twelfth Street the mains run on alternate east and west streets, Thirteenth, Fifteenth, Seventeenth, Nineteenth, etc., to a manhole at the intersections of the alleys, from whence a secondary line is run either way to a pole at the entrance of the alley, and the distribution effected from a cable box by short overhead lines in the alley to the telephones of the subscribers.



CONCRETE AND I—BEAM CONSTRUCTION OF TOP OF MANHOLE.

This company selected the hollow brick tile conduit as the best for its purposes, considering it the most durable, easiest for drawing in cable, and on account of its short length when well laid making a straighter and truer system, and with a very much lower percentage of loss due to breakage. This saving, however, is partly counterbalanced by the cost of laying and jointing a conduit of single duct formation, though it proves most serviceable when obstructions are met and have to be circumvented, where curves in the conduit construction are found to be necessary, and where "tapering" is desired.

The tile furnished was made by the local firm of Evens & Howard in 18-inch sections, 3¾ inches circular opening, five-eighths inch wall and octagonal exterior, at a price of about 3½ cents per duct foot, from sewer pipe clay burned moderately hard and glazed inside and out. They are laid 5½ inches between centres, the interstices being filled with cement mortar and with a half-inch layer spread on top of the tier of ducts. The joints are made abutting with a layer or casing of mortar surrounding them, 1 part of cement to 2 of sand, and are broken vertically and horizontally, a mandril being drawn through to preserve the alignment and prevent the mortar from entering the duct. This mandril consists of a piece of wood, 3 feet long, that will just clear the duct, and has a cleaning washer attached to the inner end and a hook for withdrawing at the working end.

The conduit is laid upon a concrete foundation ranging from 4 to 6 inches in depth, according to the number of ducts to be laid, the width of trench being almost uniformly made to accommodate four ducts laid side by side, and is protected upon the sides with from 3 to 4 inches of concrete with 4 inches on top as an encasement. This concrete consists of 1 part cement, 3 parts sand and 6 parts broken stone, all the cement used being a superior brand of American Portland. Although the city regulations only require a space of 20 inches from the top of the pavement to the top of the ducts, the practice of the engineers of this company has been to place their ducts an average of about 36 inches below the surface where heavy traffic in the streets is expected. It is also their practice to go under rather than over obstructions, although under exceptional circumstances a "split" might be made, going both over and under the obstruction.

The average length of a block in St. Louis is from 300 to 400 feet, and unless something unforeseen arises the street is not kept open over three days, one day being required to open the trench and put in the concrete foundation, which is left over night to set, a second day allowed for the laying of the duct and putting in the concrete encasement (which is also allowed to set over night), and on the third day the filling-in is done, concrete for the street put in and repaving completed, finishing the work on the street, with the exception of the manholes. This trench work requires the employment of about thirty laborers, six pipe layers and their helpers, ten concrete men, and six pavers and helpers for a trench in which twenty ducts are installed.

Besides this hollow brick tile two other styles of conduits are to be used in this work, "four-duct tile" and "distributing conduit," both made in St. Louis by the Blackmer & Post Pipe Company, and composed of hard-burned clay, with a salt-glazed surface.

The four-duct tile is better understood from the illustration than from a description; it consists essentially of a clay trough with three partitions, forming four rectangular compartments 3¾ inches wide by 4 inches high, the walls being 1 inch thick. It has been made in 2-foot lengths only and weighs about 85 pounds to a section, and costs between 4 cents and 5 cents per duct foot. It can only be economically used as at present made where multiples of four ducts are installed, and is built up one section on top of another, the bottom of an upper layer forming the top of an under layer, the bottom being fitted with a groove to tongue into the walls of the section underneath. As in laying all styles of conduit, the concrete encasement on the sides is put in with each successive layer

of conduit, the foundation and general work being the same as for the hollow brick tile. The top of the top layer consists of a plane sheet of mild steel, No. 22 gauge, bent to lap over the sides to keep it in place and then covered with concrete. This tile was made as an experiment and proved eminently satisfactory, as it can be

Manhole at Entrance to Telephone Building, Showing Eighty-Six Ducts and Iron Pipes.

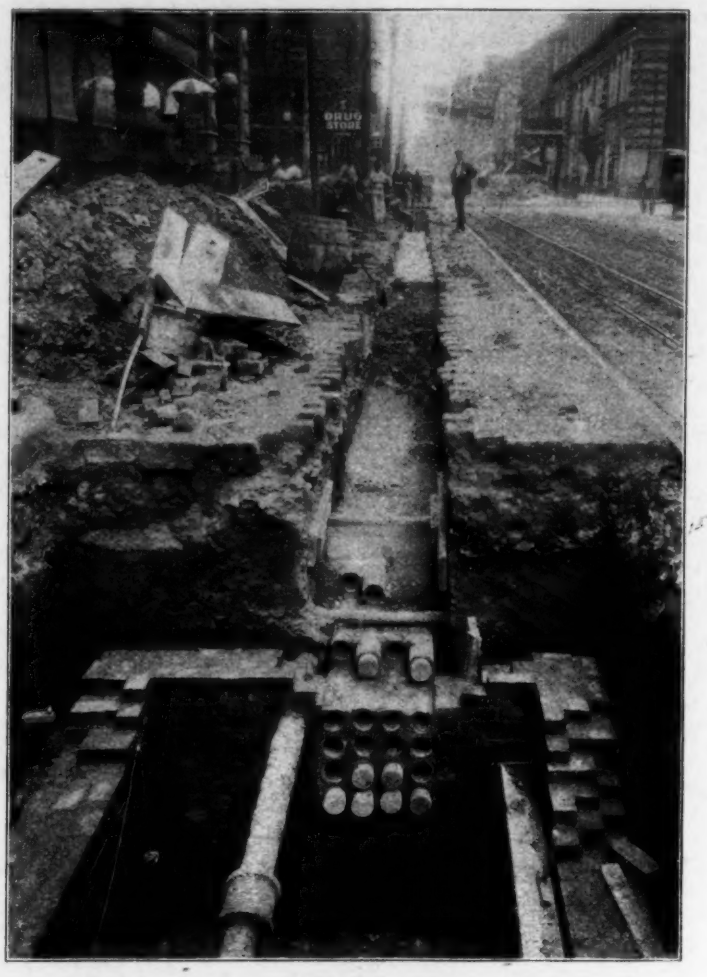
very rapidly laid, about 2500 feet being put in by one pipe layer and helper in a day. Of this style of conduit about 2000 feet have been put in.

The distributing duct conduit, another kind here installed for the first time, will be readily understood from the illustration. The lower central duct, having a 4-inch square opening, is for the main cable running to the manhole in the alley in the centre of the block, from whence it branches out through a junction box to the distributing wires, the two 4-inch openings on either side of it being

Manhole Showing Twenty-Five Ducts Entering Vault.

for the distributing wires or cables which are run out to the buildings to be connected, on either side, through underground laterals consisting of 3-inch iron pipe. The upper duct, over the cable duct, is for the rodding and the drawing in of additional wires in the distributing ducts, a runner with projecting arms extending over the distributing duct being pulled in here, the rod wires being drawn into the distributing ducts from these arms without in the least disturbing the wires already in place. This duct is simply for the use of this runner and when not in service remains empty. The cover for this duct, like the four-duct tile, consists of an arched sheet of mild steel, No. 22 gauge, lapping over the sides and supporting a concrete roof above until it sets. It is expected to use this distributing duct in conjunction with the main feeders of hollow brick tile, as the secondary conduits in minor streets and alleys, this plan of distribution and the form of the conduit being designed by Mr. W. H. Johnston, an engineer of the telephone company, who has the direct supervision of all this work.

It costs the same as the four-duct tile, is made in 2-foot lengths,



Hollow Brick Tile Entering Manhole.

15 inches wide and 6 inches high, and about 60,000 tile feet will be put underground.

Where obstructions have to be surmounted or circumvented, the distances being short and curves sharp, the use of iron pipe, 3½

Hollow Brick Tile "Fanned Out" to Avoid Obstructions.

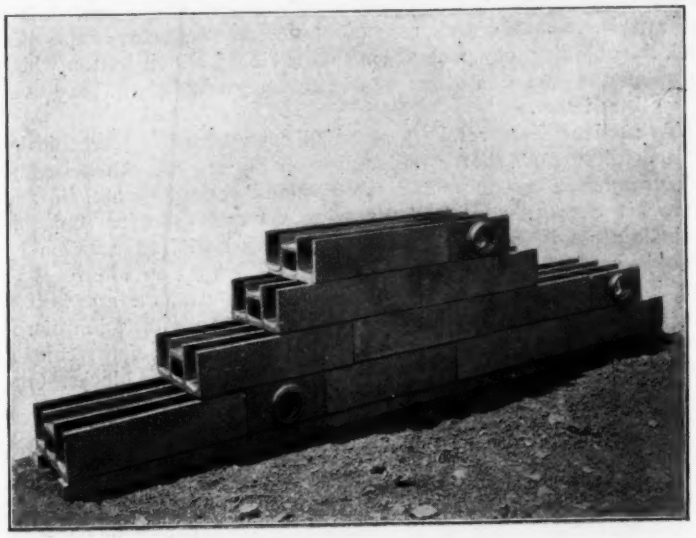
inches in diameter, has been decided upon, about 12,000 feet being employed throughout the system, joints being made by the usual iron coupler.

In the construction of manholes four sizes have been adopted, de-

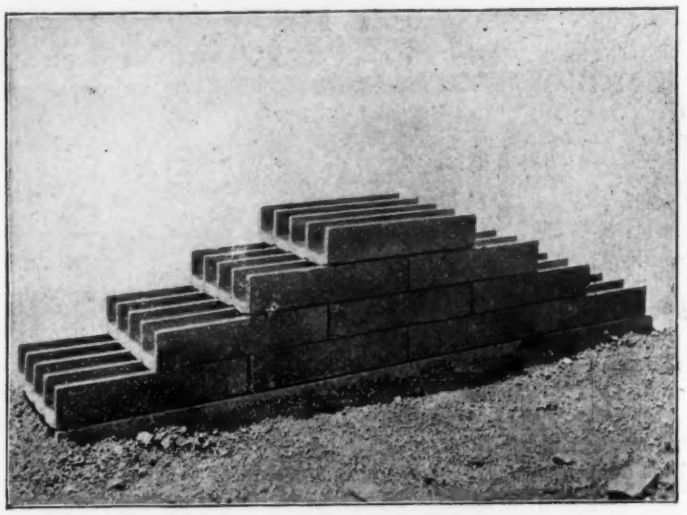
pending upon the number of ducts entering the hole, 3 × 3 feet, 4 × 4 feet, 5 × 5 feet and 6 × 8 feet, the 5 × 5 feet predominating, and all having 5 feet head room. The smaller sizes have 9-inch walls, and the larger 13-inch walls, all having 4-inch concrete bottom with sewer connections, where practicable, and a 10-inch concrete roof, supported by I beams, with rectangular opening, having a 24 × 30 inch cover. Upon this roof rests a cast-iron frame, weighing 350 pounds, having a 200-pound steel cover fitted with a gravity latch to lock the cover when closed. The brick used is a hard-burned sewer brick, making the vault moisture proof, and where there seems to be no indications of gas collecting in the manhole a solid cover is used; where gas is anticipated a ventilated grated cover is put on, having a dirt pan underneath to catch surface dirt.

OPEN TRENCH SHOWING HOLLOW BRICK TILE CONDUIT.

Where the ducts lead into the telephone building on Tenth Street a very large vault has been made, 12½ × 24 feet, with 8 feet head room and 18-inch walls. These walls are made with a 1-inch air gap on the inside course to exclude moisture, a sewer trap and connection being placed in the bottom of the vault. The bottom is concreted and the top made of the usual I-beam and concrete construction, an entrance being effected through an opening in the top. In the south wall of this manhole twenty-five ducts open, being the main line south on Tenth Street; in the north wall eighty-six ducts open, being three sets of ducts, four ducts to a layer, each set having a separate and distinct concrete encasement and being separated from the next adjoining set by 1 foot of concrete. The easternmost set consists of twenty-three ducts and is



JOHNSTON DISTRIBUTING DUCT, SHOWING OPENINGS FOR LATERALS.



FOUR-DUCT TERRA COTTA TILE.

TRENCH WORK. HOLLOW BRICK TILE ABOUT TO BE COVERED WITH CONCRETE.

HOLLOW BRICK TILE MAKING CURVE OVER TUNNEL.

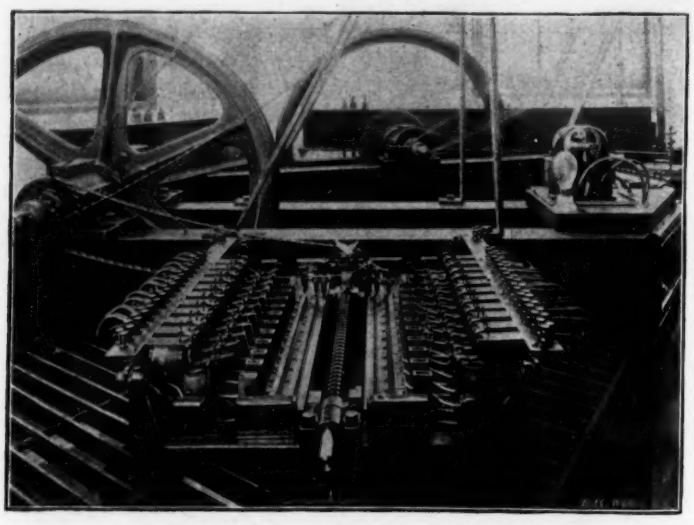
for the main trunk going east on Olive Street, supplying the eastern part of the city; the middle set contains twenty-four ducts, and is the main line going north on Tenth Street, providing for that part of the city north of the centre of distribution; the westernmost set has thirty-nine ducts and is the backbone going west on Olive Street and taking in all the western end of the city, the main residence portion.

This work when completed will comprise about 20 miles of trench, 600,000 duct feet of conduit and 425 manholes, and will cost at a rough approximation $400,000. The cost of the manholes, including covers and sewer connections, is estimated to be as follows: 3 × 3, $55; 4 × 4, $60; 5 × 5, $75, and 6 × 8, $90, it being shown that two masons and a helper can construct one of the large size manholes in a day. Bagnell & McDonald, of St. Louis, are the contractors for this work, which is being done conjointly for the Bell Telephone Company of Missouri and the American Telephone & Telegraph Company (Long Distance Telephone).

The Bell Telephone Company, as well as the Kinloch Telephone Company, has contracted with the Standard Underground Cable Company for its cable installations, enormous quantities of cables being required in each case, the former company using 30, 60, and 120 pairs cables and the latter 15, 25, 50, 75 and 100 pairs.

Elevator Calling Signals at the New York Telephone Building.

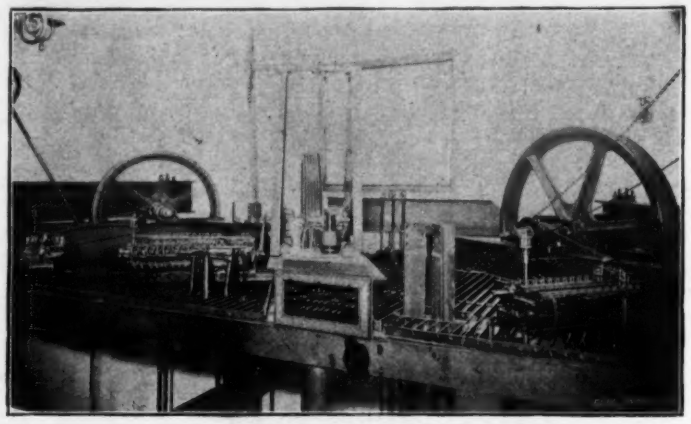
Wherever banks of high-duty passenger elevators are operated in a modern office building, it becomes of prime importance to provide



Main Commutator Switch and Control Magnets.

some means whereby the intending passenger on any floor may signal his desire to go up or down to the operators in the various cars, so that each may be suitably operated. With the present high-class elevator service, now becoming so prominent a feature of such structures, it is of the utmost importance to keep the various elevators running on schedule time, and land the passengers at their respective floors with the greatest comfortable speed. Yet every facility must be afforded the waiting passenger at any intermediate floor to avail himself of the elevator service in either direction with the smallest loss of time and with the minimum of exertion on his part. The calling method in vogue in many installations has very serious objections, although it is certainly the acme of simplicity. Aside from the annoyance created by the almost continuous calls of "up" or "down" from the waiting passengers at the various floors, the service rendered is very poor, particularly with high-speed service. The passenger, in the majority of instances, does not call until the car has proceeded too far to make the floor landing, and, where the operator is sufficiently accommodating, must return. In addition, therefore, to poor service, inefficiency also results, as one of the prime economical requisites of good elevator service is to make quick, exact stops and continuous trips. The use of individual floor annunciators located in each car, and indicating up and down for each floor, operating in conjunction with up and down pushes on each landing, eliminates many of the previously mentioned difficulties. Yet there is still an opportunity for confusion in answering the signal, owing to the fact that the signal is received in all cars. In order to meet the exact requirements such a signal system should only communicate with the nearest up or down car approaching the landing at which the respective button has been operated. Such a system has just been installed at the new Telephone Building in this city, working in conjunction with the Sprague high-duty electric elevator equipment (consisting of three machines). This new calling system was installed by the Elevator Supply & Repair Company, and possesses several exceedingly novel features.

At each floor landing two ordinary push contact buttons are

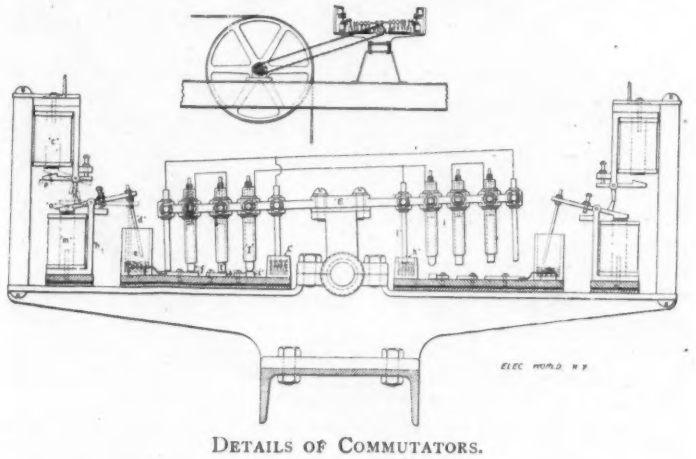


Switch Mechanism on Top of Elevator Shaft.

neatly mounted on an ornamental block set in the hoistway frame. These buttons are marked "up" and "down," and are normally open. The car signal consists of a small colored incandescent lamp, inclosed in an opalescent globe and ornamental holder. This lamp is illuminated when the car approaches within one floor of the one on which the operated button is located, and is automatically extinguished shortly after the car has left the floor. These features are adjustable. Should it be inconvenient to stop on receipt of this signal, the operator may push the normally closed circuit button, which prevents the operation of the signal for that particular car, but leaves the others intact.

To produce these results a so-called commutator is mechanically connected to each sheave mechanism on the top of each hoistway. The commutator consists of a screw spindle rotated by a chain and sprocket connection with the moving car-cable sheave. On this spindle a nut is moved longitudinally, being held from rotation by two diametrically opposite contact arms. When the spindle revolves in either direction the friction between the nut and the screw shaft is sufficient to carry the former slightly over in the direction of rotation, raising the contact arm on the opposite side of the contact blocks, while the other is pressed down on the opposite blocks. One of the commutator devices is fitted with a set of controlling magnets, which are connected to the contact buttons and control the light contacts. All contacts on one side are for down signals, those on the other for up. The magnets are similarly arranged. The diagrams show the arrangement and connections.

On each side of the screw spindle is a continuous contact strip,



Details of Commutators.

followed by a parallel series of release magnet and car-signal light contacts. All of the various contacts are in multiple. The arrangement of the magnets will readily be seen from the illustration. Their function is to control the light signal contacts. The upper row of magnets on each side are connected and controlled by the landing pushes, those on one side being controlled by the up push and those

on the other by the down. When any one of these magnets is energized by the completion of the circuit through the button, it attracts its armature and thereby releases the armature of the lower magnet, to which a switch arm is attached, which, dropping into a mercury cup, connects the corresponding light contact. This mercury switch is held closed by its own weight, and remains in this position until the release magnet is energized, acting on its armature and raising the contact arm out of the mercury cup. As the car moves up or down the shaft the contact brushes on one or the other of the arms are brought into connection with the various release magnet and light contacts. When the light contact, whose circuit has been closed by the magnetically operated mercury switch, is connected to the moving contact arm, the car-light circuit is closed through the lamp in

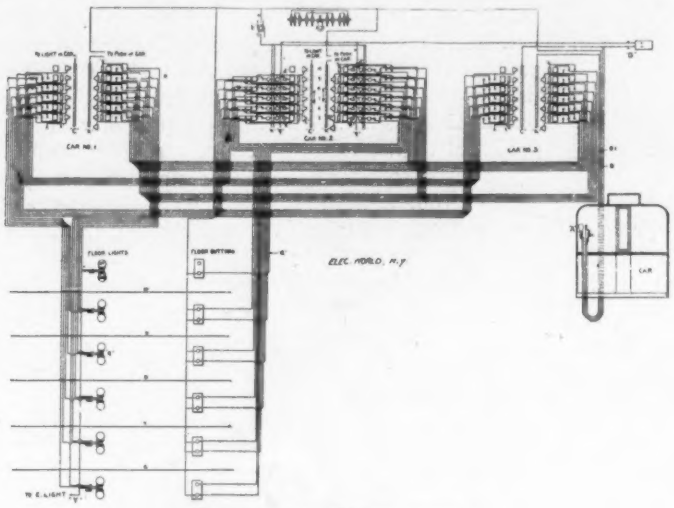


DIAGRAM OF CONNECTIONS.

the car and signals the operator to stop. When the contact arm leaves this contact block the light is extinguished, and the mercury switch is opened when the contact arm comes in connection with the next block, on a line with which is also the release-magnet contact of the previously operated mercury switch. The connection of the latter circuit energizes the release magnet, and allows the switch-operating armature to return to its normal position. In the diagram are shown an additional row of contacts adjacent to the car-light contacts on each side. These control lights are located on the landings at each elevator shaft, and indicate whether that particular car is going up or down. This feature is omitted in the Telephone Building plant.

If a button should be pushed, and the first approaching car either up or down be fully loaded or otherwise unable to take on the passenger, the operator pushes the button in the car which is connected in series with the release magnet, and this prevents the completion of the circuit when the terminal comes in contact with the arm. The next approaching car will, however, receive this signal, as the switching magnet remains closed until the release magnet is energized. It will be noted that all the release magnet and light terminals are in multiple, so that one set of up and down magnets may control any number of floor pushes and commutators. In this installation there are twelve floors and three commutators.

For supplying current to this signal system a small motor generator is used, taking current from the 110-volt lighting circuit of the building, and reducing to about 10 volts, at which it is supplied through the commutator terminals and landing pushes to the closing and releasing magnets. It will be noted that this part of the apparatus is entirely free from the car-signal lights, which are supplied from the 110-volt line, which is connected from a central point in the hatchway to the car, the two-car release wires from each commutator being carried in the same cable.

New Officers of the Engineering Education Society.

The Society for the Promotion of Engineering Education, at the closing session of its Toronto meeting, elected the following officers: President, Prof. J. B. Johnson, Washington University; vice-presidents, Dr. T. C. Mendenhall, Worcester Polytechnic Institute, and Dr. H. W. Tyler, Massachusetts Institute of Technology; treasurer, Prof. J. J. Flather, Purdue University, and secretary, Prof. A. Kingsbury, New Hampshire College.

Note on Stable and Unstable Synchronous Motor Running.

BY W. S. FRANKLIN.

In his excellent treatise on alternating current phenomena, Mr. C. P. Steinmetz discusses the characteristic curves of the synchronous motor, namely, the curves showing the relation with constant load, betwen current and motor E. M. F. He calls attention to the fact that only a portion of each of these curves can be determined by observation, and expresses the opinion[1] that the remaining portion may probably correspond to conditions of synchronous motor running which are unstable. The object of this note is to show that this is, in fact, the case.

Let z be the total impedance of the circuit, r its resistance, E_0 the

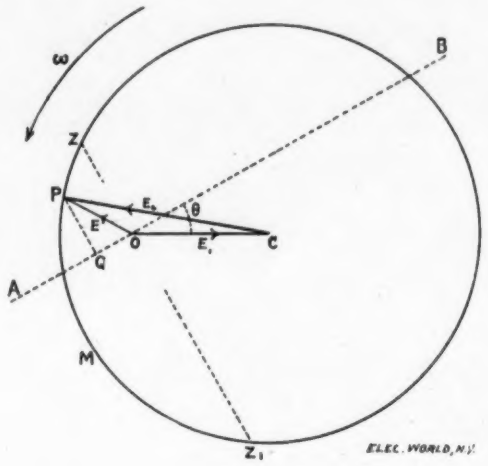


FIG. 1.

E. M. F. of the generator, and E_1 the E. M. F. of the motor. Draw a line $O\,C$, Fig. 1, representing E_1. Describe a circle with its centre at C, and radius representing E_0. Then $O\,P$, drawn from O to any point of the circle, represents a possible value of the resultant E. M. F. E. Draw a line $A\,B$ through O, making with $O\,C$ the angle Φ of which the cosine is $\frac{r}{z}$. Then $O\,Q$ represents the intake of the motor when the phase relations of E_0 and E_1 are as shown. The intake is zero when P is at Z; it becomes a maximum at M, and

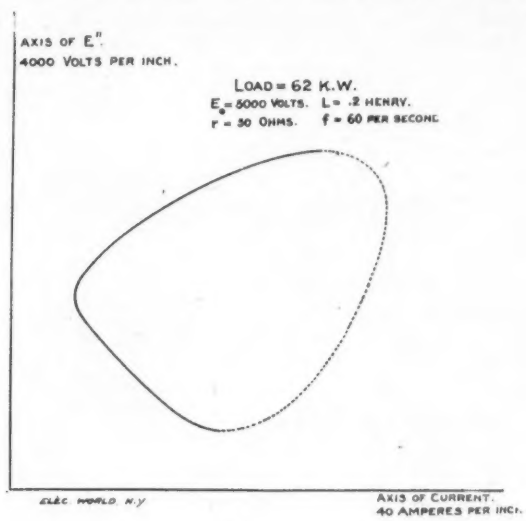

AXIS OF E".
4000 VOLTS PER INCH.
LOAD = 62 K.W.
E₀ = 5000 VOLTS. L = .2 HENRY.
r = 30 OHMS. f = 60 PER SECOND.
ELEC. WORLD, N.Y.
AXIS OF CURRENT.
40 AMPERES PER INCH.

FIG. 2.

falls to zero again at Z^1, as the point P moves in the direction of ω.

A motion of P in the direction of ω corresponds to a falling behind of E_1, relative to E_2, that is, to a lagging of the motor.

If the intake of the motor increases as it lags behind the generator, its condition of running is stable, otherwise its condition of running is unstable.

Therefore, the region $Z\,M$ is the region of stable running, and the region $M\,Z^1$ is the region of unstable running of the synchronous motor.

[1] Steinmetz's "Alternating Current Phenomena, p. 228.

For any given load, that is, for any given length OQ, there are two positions of the point P, or two values of the resultant E. M. F., or two values of the current. For the lesser current, the motor is in a condition of stable running, and for the greater current the motor is in a condition of unstable running.

The curve Fig. 2 shows the relation between current and motor E. M. F. for constant load. The portion drawn in full line can be determined by observation; the dotted portion cannot.

On a New Method of Measuring Hysteresis in Iron.*

BY J. L. W. GILL.

When a specimen of iron is passed to and fro through a magnetic field without any motion of rotation, the direction of the field being reversed each time the specimen passes out of the field, the iron passes through a complete magnetic cycle for each cycle of motion, and a definite amount of energy is lost, due to hysteresis in the iron. Since energy is supplied only in the form of mechanical work upon the specimen, the hysteresis loss is, by the law of the conservation of energy, numerically equal to the resultant mechanical work expended.

The instrument described below is based upon the above principle, and its function is to measure the work so expended.

The magnetic field is obtained by the use of a solenoid wound on a brass tube. This solenoid is arranged vertically and has a vertical motion, the ends of the solenoid being fitted with collars, which slide on two rigid vertical rods. An arm is fastened rigidly to the solenoid, and extends out on one side. To this arm is fastened a cord, which passes over a grooved pulley vertically above. A balance-weight is attached to the other end of the cord. By rotating the grooved pulley the solenoid may be moved up and down, and will remain in any desired position. The specimen to be tested is placed in a stirrup, which is sufficiently small to pass through the solenoid, and is suspended by a helical spring, the point of suspension being vertically above the centre of the solenoid. Another helical spring extends from the bottom of the stirrup to a point vertically below. This serves to keep the stirrup steady. The stirrup is suspended so that when the solenoid is in its lowest position the specimen is out of the magnetic field, being above the solenoid. As the solenoid is moved up the stirrup and specimen pass through it, and when the solenoid is in its highest position the specimen is practically out of the field. If the solenoid be moved once up and down, the field being reversed when the specimen is out of it, the specimen passes through a complete magnetic cycle, provided the specimen has been once through the field and is initially in that particular cyclic state.

As the solenoid is moved up the specimen is attracted down, the force of attraction increasing until it reaches a maximum, when about one-half of the specimen is inside the solenoid. The attraction then decreases and becomes zero when the specimen is in the centre of the solenoid. Up to this point work is being done by the magnetic force. As the solenoid is moved up to its highest position the specimen is attracted upward, and work is done against the magnetic force; the attracting force becomes a maximum when the specimen is about one-half out of the solenoid on the lower side, and becomes zero when the solenoid is in its highest position. The maximum force in the second half of the motion is greater than the maximum force in the first half. The work done in the second half of the motion is also greater than that done in the first half, the difference being the work expended in taking the specimen through half a cycle. When the field is reversed and the solenoid moved down, the action is similar to that which takes place when the solenoid is moved up, and the resultant work done will be the same, provided the specimen is homogeneous.

The resultant work done on the specimen may be determined by observing the attracting force when the solenoid is in different positions, and then drawing a distance-force curve. The integral of this curve gives the resultant work done on the specimen. The force at different points can be determined by calibrating the springs which support the stirrup, and then observing the extension of these springs. The author has determined the hysteresis loss in different speciments at different inductions by this method, the extension of the spring being observed with the aid of a microscope.

To make this method practical, a simple integrating apparatus is attached to the instrument above described, by which the work done is integrated automatically. A glass disc is connected rigidly to the pulley which moves the solenoid, so that when the pulley rotates the glass disc rotates in its own plane, which is vertical, the axis of rotation passing through its centre. The motion of the glass disc is therefore proportional to the motion of the solenoid. An arm is fastened to the stirrup which supports the specimen, and extends up to the glass disc. This arm supports a graduated steel disc, which is free to rotate in its own plane about a vertical axis through its centre. This steel disc presses lightly on the glass disc, the point of contact being at the centre of the glass disc. When the solenoid is moved up the specimen is attracted down, taking the stirrup with it. This causes the steel disc to recede from the centre of the glass disc. A motion of rotation is then communicated to it by the glass disc, the speed of rotation depending on its distance from the centre; since its distance from the centre at any instant is proportional to the attracting force, and the motion of the glass disc is proportional to the motion of the solenoid, the speed of rotation of the disc is proportional to the work being done at that instant. The total amount of rotation is therefore proportional to the total work done. Consequently all that is necessary to test a specimen with this instrument is to place the specimen in the stirrup, move the solenoid up and down to get the specimen in a cyclic state, then take it through a cycle, and observe the amount of rotation communicated to the steel disc. This is a direct measure of the work expended.

The constant of the instrument is determined by placing a known weight in the stirrup, and observing the amount of rotation communicated to the disc when the solenoid is moved through a known distance.

The specimen may be taken through a number of cycles and the readings allowed to accumulate. The average of a number of cycles is thus obtained.

*Abstract of a paper read at the Toronto Meeting of the British Association.

Annual Meeting of the American Electro-Therapeutic Association.

The annual meeting of the American Electro-Therapeutic Association will be held in the building of the Harrisburg Academy of Medicine at Harrisburg, Pa., September 21, 22 and 23. The first floor of the building will be allotted to exhibitors of electrical and electro-therapeutic appliances and supplies, while the sessions of the association will be held on the second floor. There is a well-lighted dry basement that may be used by exhibitors for storage. The Harrisburg Electric Light Company will furnish the Edison direct current of 110 or 220 volts. Batteries may be placed in the basement to connect with apparatus on the exhibition floor. Space 5 x 8 feet, with tables 3 x 8 feet, or without tables as desired, will be rented to exhibitors at low prices for the time of the meeting. Those desiring space should address Dr. Wm. J. Middleton, Steelton, Pa., stating whether space only or a table is wanted, and if power is desired. The Academy building is at the corner of Second Street and Barbara Alley, centrally located and well lighted.

Boston's Subway Opened.

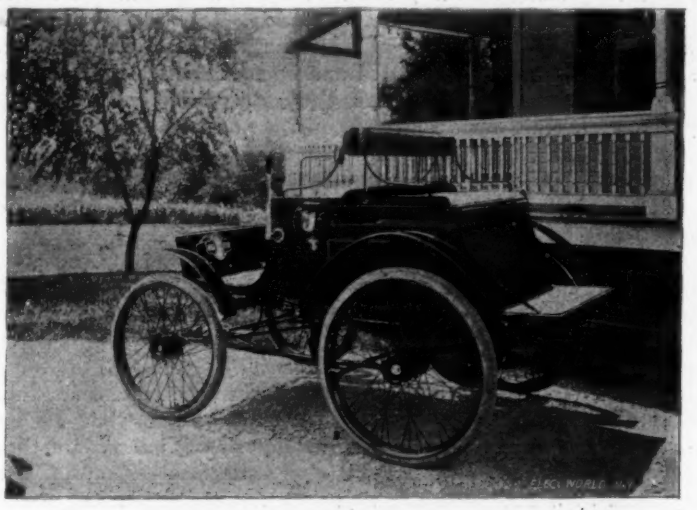
The Boston subway for trolley cars was opened to the public early on the morning of September 1. There was little or no demonstration in connection with the event other than that occasioned by a great rush to ride on the first car entering the big hole. An open car of the Allston line, in charge of James Reed, motorman, and Gilman S. Turfent, conductor, was the first to enter. From the Public Garden entrance to Park Street the trip was made in a little over four minutes. From this time on there was a stream of cars, about three to the minute, all of which carried large loads.

Up to noon it was estimated that almost 50,000 people had ridden in the subway, and this number was increased to over 100,000 when the gates were closed at midnight. At present only the Boylston Street and Tremont House cars are using the subway, but the Tremont Street and Shawmut Avenue entrance is very nearly completed, and will be in use by another month. The cars only run north as far as Park Street. The contract for building the last section to the Union station has been awarded and work started. The Transit Commissioners believe that before next summer the entire subway will be in use and Tremont Street entirely free from cars.

The Riker Electric Trap.

The development of the motor-propelled road vehicle will probably result in the perfection of two distinct types. One will take the place of the present light carriages, road wagons and traps used for pleasure and light business purposes by private individuals and concerns who will themselves maintain and operate the conveyances, while the other will be for public use or heavy business purposes, forming the rolling-stock equipment of the future cab, express, delivery wagon and 'bus services, and will be operated by skilled drivers and maintained and handled by a regular force of employees for this purpose. A slight consideration of the conditions governing both will indicate certain features which are almost absolutely essential elements of the vehicle intended for the first class, but which may be omitted in the second. Simplicity and freedom from intricate mechanism, absolutely automatic action, and, as far as possible, control and prevention of injurious results due to careless or ignorant handling are the prime considerations where the vehicle is for private use and is to be handled by novices.

A recent article in THE ELECTRICAL WORLD fully described the complete electric-cab service in New York City. Among those who have, howeve , been working rather in the other direction is Mr. Andrew L. Riker, of the Riker Electric Motor Company, whose pioneer productions have already been noted and have resulted in the perfection of a line of electric-motor vehicles of which the present so-called "trap" furnishes an excellent example. The general features of this new motor conveyance are also included in the construction

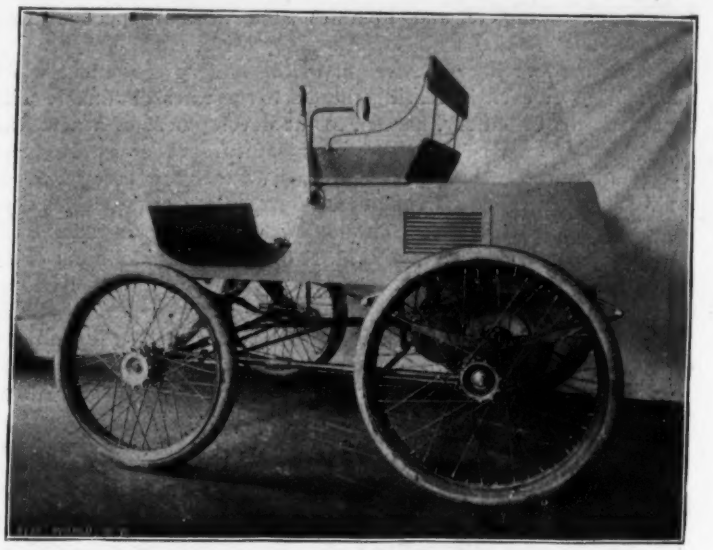


REAR OF FINISHED CARRIAGE.

of others, among which are light buggies and delivery wagons now being developed. The first Riker vehicle of this type was constructed some years ago, and won the race at the Rhode Island State Fair in 1896. It was of the separate tubular motor truck and body type, with two separately geared driving motors, short hub pivoted axle steering gear, and rear drive.

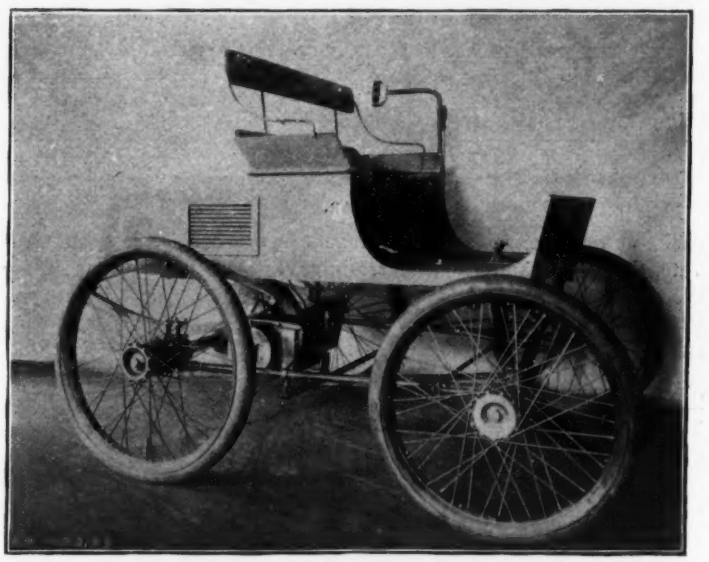
The new vehicle is particularly notable for its elegance of design and light and non-mechanical appearance, and yet combines certain features of construction which make it inherently strong and capable of being handled by laymen over any road. It is of the *dos a dos* double-seated trap type, the upper body scarcely differing from that of any similar horse-drawn conveyance. It is to be noted that in this particular construction the box body, which acts as a battery receptacle, becomes very unobtrusive.

In designing the lower frame or truck, which is fitted with the complete running gear and upon which the body is flexibly supported at each end by flat compound double springs, the aim has been to provide the necessary strength and rigidity of construction, combined with lightness, and to rather follow the truck idea only so far as is necessary to support the wheels, driving gear, motor and steering gear, and to provide some means of longitudinally bracing the two sets of wheels on a line as near as possible coincident with the direction of greatest strain. The frame consists of a 1¼-inch single steel tube construction. Tangent-spoked metallic 3-inch pneumatic-tired wheels are used, the driving wheels being 36 and the steering wheels 32 inches in diameter. The wheel base measures 6 feet. The transverse tube at the front end of the frame projects at each end, and is suitably fitted with the steering wheel pivots. Centre hub pivoted steering gear has been adopted. A bearing shell is trunnion pivoted to projecting ends of the front bar. The wheels rotate on two circles of bearing balls, one at each end of the cylindrical shell, and bearing and side-thrust pressure are taken up on the same. From each pivoted-bearing shell there is a rearwardly projecting arm at right angles to the wheel axis, and the end of one arm is connected by a rod across to the other, the outer free end of which, in turn, is connected by a rod with the steering rod which pro-



STEERING GEAR, SPRING SUSPENSION AND MOTOR BRAKE.

jects upward centrally in front of the seat and terminates in the bent handle arm. A single motor, rotating axle and fixed-wheel driving gear have been adopted. It has been found from practice and trial that, all things considered, the single motor plan, although necessitating balance gears, has various economical advantages. The rear ends of the longitudinal frame tubes are flexibly fitted to the rear cross tube by means of spherical bearings. This movable connection gives the frame great flexibility, permitting transverse oscillations without serious effect. About midway between the wheels the rear tubes join in a gear casing. At the

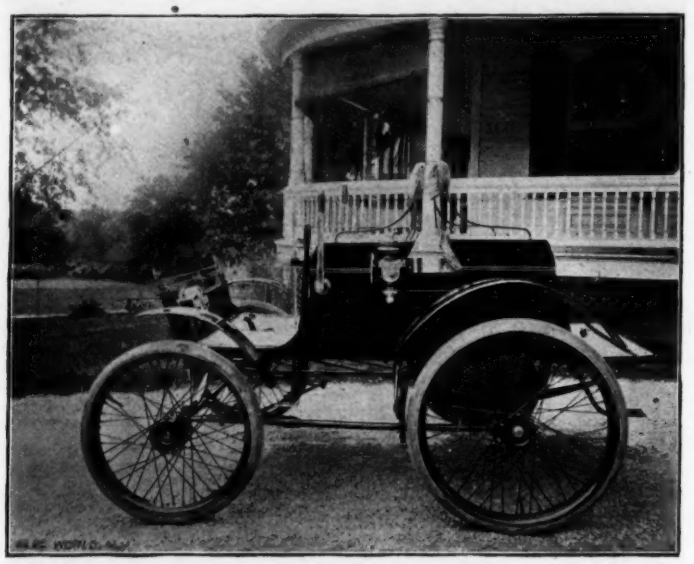


MOTOR, STEERING POST AND BRAKE PEDAL.

enlarged outer ends of the rear tube under each spherical side tube bearing is a ball bearing for the split rotating axle, to the outer ends of which the wheels are rigidly fitted. The inner ends pass through the tubular casing, and each is connected to one side of a balance gear, inclosed in the gear casing, but easily accessible. This gear runs in oil, and the split shaft has another bearing on each side of the balance gear. The central or driving member of the balance gear coacts with the motor-driving pinion fitted to the motor shaft, which projects into the casing. This makes but a single reduction gearing.

A motor of special design has been adopted. It is of a rectangular multipolar-frame type, with two wound and two salient poles. At one end the motor is swung by means of double-bearing clamps on the rear tube at the side of the gear casing, and at the other it is held by a double-spring suspension. The sides through which the armature projects are entirely encased by aluminum jackets having movable covers. The motor is series connected, with sectional-wound cast steel field. The armature is form wound on a slotted core, and has a large commutator. Its normal capacity is 2 kilowatts, at 80 volts and 25 amperes, but it will stand a very large overload. It weighs 142 pounds complete, and operates at a normal speed of 1000 r. p. m.

The desire to reduce the weight of the battery equipment while maintaining or even increasing the discharge rates obtainable with present forms of battery, has led to the development of a new lead zinc type of storage cell, whose performance, from the figures given, is certainly most excellent. The positives of this new battery are of lead, while the negative is composed of a zigzag band of electrically-deposited zinc-coated copper alternating with each lead plate. This combination gives an average E.M. F. of 2.3, and a maximum of 2.5 volts. Each cell, as used in the vehicle, consists of a rubber-retaining jar, six positive plates, measuring 6½ x 6 x 3-16 inches, weighing 28 ounces, and a single negative consisting of a zigzag zinc-copper band. The complete battery equipment consists of thirty-six such cells, arranged in four boxes or trays of nine each, weighing 190 pounds, and making a total battery weight of 760 pounds. Considering that this battery has at 2.3 volts per cell a 150 ampere hour capacity at a ten-hour rate, or 120 ampere hours capacity at a four-hour rate, the weight and size are certainly very small. A door under the rear seat gives ready access to the battery box, and the four battery trays can be easily placed or taken out, connections being automatically made.



Finished Carriage, Showing Operating Devices and Steering Gear.

In the arrangement of the controlling devices it has been particularly desired to first provide safety, automatic action and simplicity. This is clearly exemplified by the braking apparatus. Two brakes are provided, one a band brake acting on a brake pulley on the motor shaft, and actuated by a pedal, and the other a shoe brake, acting on the tire of the driving wheels, and operated by an upright hand lever at the left of the front seat. This double-braking gear furnishes an element of great assurance to the operator, who can always rest satisfied that at no matter what speed the vehicle is operating, one or the other or both of these devices is at hand.

Probably, however, the most novel and interesting element in connection with this vehicle and that which gives it its automatic features, is the peculiar system of electric control and regulation. At the left of the front seat will be seen an upwardly projecting lever. This lever is fitted to the spindle of the controller, which is located under the seat A series parallel control is effected by means of this controller between the batteries and motor, giving four combinations forward and two reverse, and four corresponding speeds of 3, 6, 12 and 15 miles per hour. The controller is moved to either side of its normal position for a corresponding direction of carriage travel, the extent of movement either way determining the speed. In general construction it consists of a steel shaft, mounted on which are a number of insulated radial contact shoe arms, making various connection between a row of stationary contact terminal brushes. Aside from the operation of this controller, the driver of the carriage need not trouble himself about the proper performance of the motor or batteries, as both are protected against almost every undesirable condition by means of automatics. If, for instance, the motor should be overloaded from any cause, consequently drawing an excess of current from the battery, an electro-magnetically controlled switch automatically opens the main circuit. This switch mechanism interlocks with the controller, so that no further operation is possible until the latter is brought back to normal, and the switch is thereby automatically reset. The actuating magnet of this switch is double wound, one coil being for the above overload purposes, the other being controlled by the brake pedal, so that when this is applied the coil is energized and opens the switch as before. The importance of this element will readily be appreciated.

To the left of the dashboard will be noticed a duplex-indicating instrument. This consists of a Weston ammeter and voltmeter placed in a single waterproof casing, and indicating on a separate central scale which can readily be seen from the seat. This instrument indicates at charging or discharging. When it is desired to recharge the batteries, a double-throw triple-pole switch under the front seat is operated to the other side, connecting the batteries for charging through the controller and also the charging automatics. In addition to the indicating instruments above mentioned, a recording wattmeter is provided which is in either the charging or discharging circuits, depending on the position of the switch. This wattmeter through suitable contacts controls a charging circuit-breaker, so that when the batteries have been fully charged this circuit-breaker switch is automatically operated and opens the circuit. The same action occurs when the batteries are fully discharged and also if any part of the circuit when running should accidentally open.

It is intended that the batteries should be charged at about 110 volts, but, by charging through the controller with the motor cut out, it is possible to charge at a smaller potential by arranging them in other combinations. A rheostat is also provided in the charging circuit which will dissipate the surplus voltage up to 500 volts. In connecting the battery-charging cable to the supply conductor, no attention need be paid to the polarity, as an automatic switch is provided to take care of this condition. It is simply necessary to connect the conductors, the switch automatically connecting the suitable polarity to the corresponding battery terminal. As far as these features go, the mechanism seems to operate on the "you push the button, we do the rest" plan, and it does it positively and without complication. Another feature is the safety-stop lock switch, which is operated by a Yale lock and key, and turns off the main current when operated, guarding against malicious starting of the vehicle.

As a whole, this motor vehicle, intended to carry four persons, and easily capable of accommodating five, when its weight, which is but a little over 1800 pounds, is compared to its traveling capacity, makes a very superior showing. With the normal four-hour discharge rate, it has a capacity on good roads of 40 to 50 miles at about 12 miles per hour. The storage battery does not seem to be such an insurmountable evil after all.

Meeting of the New York State Street Railway Association.

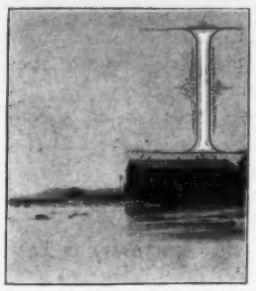
The Street Railway Association of the State of New York will hold its fifteenth annual meeting at the International Hotel, Niagara Falls, on September 14 and 15. A very interesting programme has been announced. On Tuesday evening a banquet will be given, and on Wednesday the choice of four trips is offered to the members and others present. On the evening of September 15 a ball will be given at the International Hotel, and on the morning of the 16th the entire party will be conveyed to Buffalo in special cars of the Buffalo & Niagara Falls Electric Railway, through the courtesy of that line. A large number of very interesting papers has been promised, and it is expected that the convention will be a great success.

European Management of Races.

A motor-carriage race recently took place from Paris to Dieppe, a distance of nearly 94 miles, and a railroad train took the spectators to Dieppe to see the finish, but it so happened that this train arrived at the end after the motor carriages did. The speed of the latter was 22 miles per hour, as an average over the whole course.

The Electrical Equipment of a Southern City.

BY W. E. BOILEAU.



IN 1885 the Muscogee Manufacturing Company, of Columbus, Ga., placed in their cotton mill a 20-light Brush arc dynamo for lighting their mill. One of the officers of the company, together with a few enterprising business men of the city, formed the Brush Electric Light & Power Company, and secured the use of the mill dynamo, after the mill closed for the day, and lighted a few stores. The venture proved successful beyond their anticipations, and they soon purchased a 60-light Brush dynamo and extended their circuit, doing some street lighting. The business increased very rapidly, and it was found necessary to build an entirely new plant. Both of the Brush machines had been driven from the mill water wheels, but want of sufficient room and power made it necessary to secure a new site, and a modern steam plant was decided on and built. This plant contained 500 horse-power of engines and boilers, with every improvement for economy. The engines are tandem-compound condensing, and the boilers set with a patent setting for burning cheap coal. This plant ran until March, 1896, filled to its utmost capacity, when it was purchased by the owners of the Columbus Railroad Company. It was decided to abandon the steam-power plant and extend the water-power plant of the railroad company, and to move the dynamos to the new power station. Work was commenced on the extension, and in less than a year all the lighting and power was being furnished from the new plant.

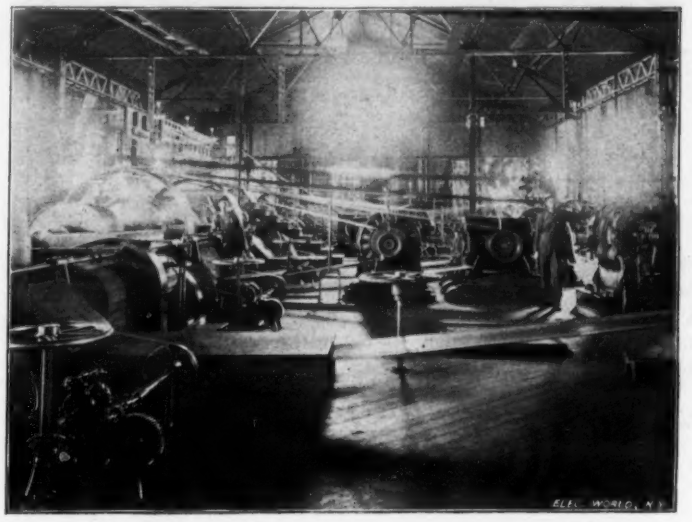
The combined power station of the Columbus Railroad Company and the Brush Electric Light & Power Company is located about one mile above the centre of the city, on the Chattahoochee River, where about 3000 horse-power is available. The station stands well

VIEW OF THE STATION FROM SWITCHBOARD GALLERY.

out in the river, adjoining the wheel-house of a large flour mill. Entrance to the station is had over a well-built steel bridge.

The building is of steel construction, covered with iron. It is 118 feet long and 47 feet wide, and extends lengthwise out in the river, thus giving an unobstructed flow of water into the penstock and a ready discharge of the tail water. The wheel pits were blasted out of the solid rock bottom of the river. The foundation walls are of rock masonry, resting on the solid rock. The floor and machinery are carried on steel I beams set in rock masonry and supported by large cast-iron columns, the average weight of which is about 6000 pounds each. These columns are securely bolted to the rock bottom. A bulkhead wall of rock masonry extends the entire length of the station on the upper side, and contains the head gates. To this wall the steel construction of the station is anchored. The wall also extends 45 feet beyond the present building, and contains head gates for an addition to the station, which will accommodate 500 horse-power more. The penstock is divided into three compartments, each of which has two large head gates. The walls dividing the penstock also have gates connecting the compartments.

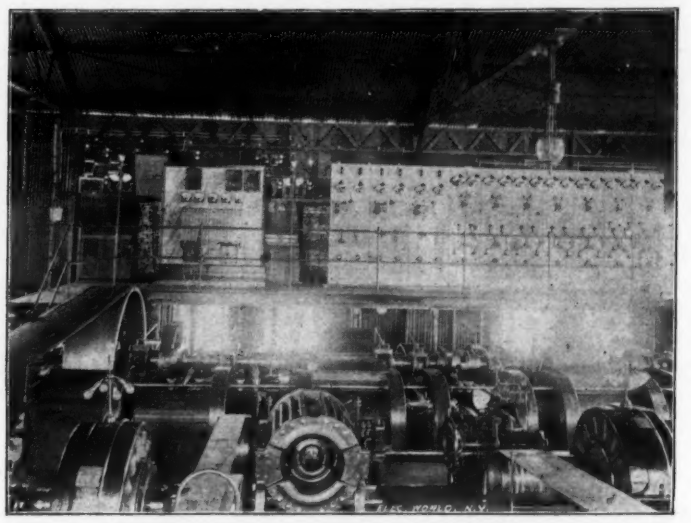
The power station contains six 68-inch vertical water wheels, known as the "Samson" turbine, made by the James Leffel Company, of Springfield, Ohio. These wheels will develop 232 horse-power each, under a 10-foot head, and run at a speed of 72 r. p. m. They are geared to a main line of shafting extending the length of the station and running at a speed of 200 r. p. m. This shaft is of hammered iron, 6 inches in diameter, and is carried on heavy cast-iron bridge-trees, bolted to steel I beams. This shaft is in sections and fitted with jaw couplings, so that any section may be run at will or all thrown together. The gear pinions are on hollow steel



A VIEW IN THE STATION.

sleeves, as are also the pulleys. The pinions have jaw and the pulleys friction-clutch couplings. The main shaft of the railroad company is in two sections, and drives two pulleys 84 inches in diameter each, and having a 28-inch face. To these pulleys are belted two General Electric multipolar 200-kw, 550-volt railway generators running at 425 r. p. m.

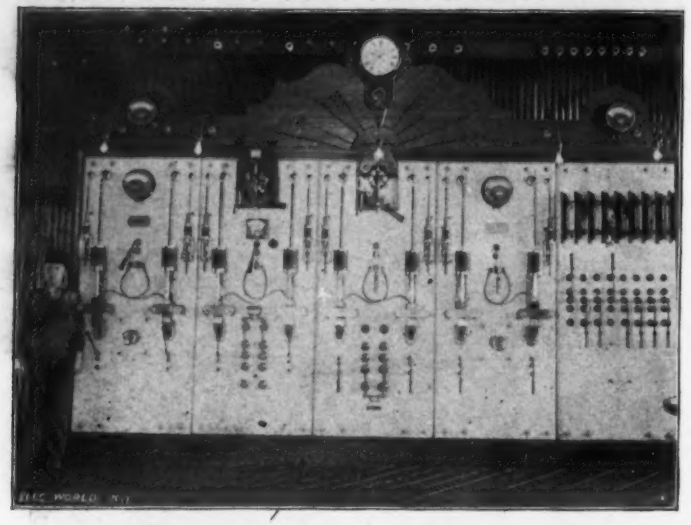
The switchboard of the railroad company is of highly polished white Italian marble. It consists of five panels, 36×84 inches. Four of the panels carry the machine switches, instruments, and Barber regulating apparatus, and the fifth is for the feeder switches.



THE SWITCHBOARD GALLERY.

A good view of this board is given in the illustration. The regulation is obtained by the Barber system of rheostats, which practically maintain a constant load on the generators at all times. The apparatus consists of four small and four large solenoid magnets, mounted vertically on the panels, for each machine. These solenoids have an iron core suspended by a spring, which is adjustable, and carry carbon-contact blocks. The small ones are connected directly across the bus-bars in such a manner that all the current going out on the lines must pass through these windings, which

consist of fifteen turns of No. 4 wire. On the small ones there is also a winding of fine wire which is connected across the circuit. The small solenoid, or relay, as it may be called, opens and closes the circuit through the large solenoid, and causes it to open or close the carbon contacts to the rheostats. There are four of these rheostats for each generator, made of coils of iron wire mounted in an iron frame. The regulators are set for a variation of 50 amperes. When the load on the line drops off 50 amperes, the contacts drop and cut in one rheostat, thus keeping up the load on the generator. In



Railroad Switchboard with Barber Regulators.

practice, the load is changing and the contacts are at work most of the time. The large contacts are provided with a magnetic blow-out that ruptures any arc that tends to form between them. While this is not the most economical method of regulation, it works perfectly, the pressure not varying 20 volts in extreme cases. A mechanical governor is also used that takes care of any slight variation of speed that may occur.

The main shaft of the Brush Electric Light & Power Company is divided into four sections, two of which belt to a countershaft, from which the smaller and higher-speed machines are belted. The new and larger machines belt direct to the first and second sections of the main shaft. The countershaft, which is of hammered

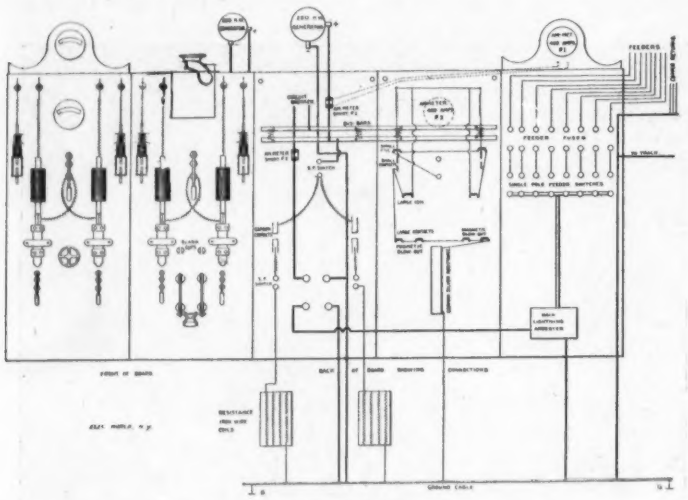


Diagram of Railway Switchboard.

iron, is 5⅛ inches in diameter and 45 feet long, and is supported on cast-iron bridge trees, bolted to steel I beams. It is driven by two 26-inch belts from the main shaft, and runs at 300 r. p. m. The countershaft is divided into five sections, the two end sections carrying the two main pulleys. The three middle sections carry one solid and three friction clutch pulleys. The sections of the shaft have friction-clutch couplings, enabling any or all of the shafts to be driven from either or both ends. Adjustable belt tighteners are provided for the main belts. All of the shaft bearings are of the self-oiling, ring type, but in addition there is a system of piping by means of which the bearings are supplied with fresh oil continually, and the old oil returned to the filter, after which it is pumped to the tank again. Pans are also placed under the bearings that catch any oil that might drip. These are also piped to the filter.

Ordinary mechanical governors are used on the wheels driving the arc dynamos. For the wheels driving the incandescent dynamos an electric relay governor, made by the Replogle Company, is used, and gives excellent results. Except for extremely heavy changes the regulation is fully as good as obtained in steam plants.

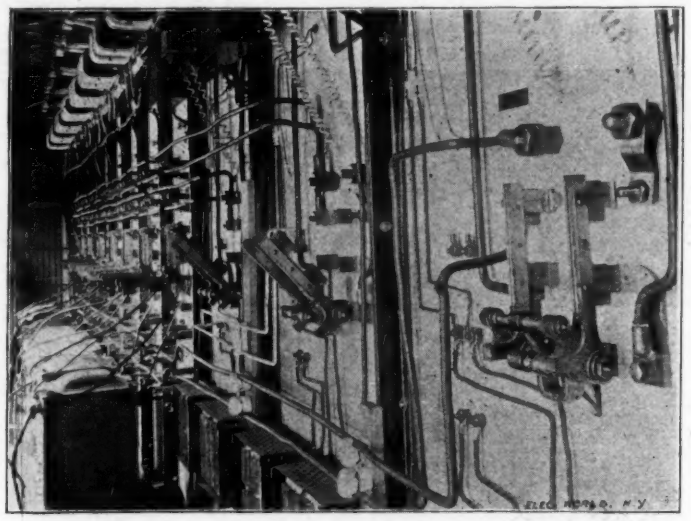
The electric equipment consists of one 125-light Brush and three 50-light T.-H. arc dynamos; three General Electric 1100-volt alternators, single-phase, 125 cycles, for incandescent lighting, having a capacity of about 4500 lights; and two Westinghouse 2200-volt two-phase 60-cycle generators of 150-kw each for power service.

The present arrangement of the incandescent generators is but temporary, the plan being to discard the smaller machines and use one 120-kw and one 250-kw generators instead, the 250-kw generator being placed in an addition to the present station.

The switchboard gallery is located on one side, extending 45 feet from one end of the building, space being left to extend it and eventually have all the switchboards on one gallery. The two-phase power board is now located on the opposite side of the station.

The arc board is one of the well-known General Electric type of plug board, is made of Tennessee marble, and has a capacity of eight machines and circuits. It is mounted to a backing of Georgia marble, which also carries the ammeters, controllers, and rheostats for the arc dynamos. On the back of this marble are a testing board of incandescent lamps and a voltmeter for testing the arc circuits for grounds, voltage, etc.

The arc lightning arresters are placed on the side of the station back of the switchboard, from which the circuits pass directly through the wall to the wire frame, extending along the side of the building. These are all of the double type of General Electric standard arc arrester. Between each arrester and the switchboard

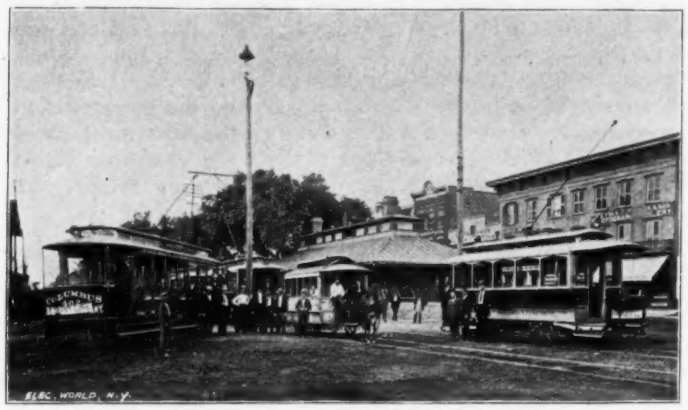


Back of Incandescent Switchboard.

is a choke coil of twenty turns of No. 6 wire wound on a wood form.

The incandescent switchboard is made of highly polished Vermont marble, and consists of three generator panels, 62 × 30 × 2 inches, with a sub-base 28 × 30 × 2 inches, and seven feeder panels, 62 × 24 × 2 inches, with sub-bases 28 × 24 × 2 inches. Each machine panel contains the following instruments mounted on the panel: Station transformer, current indicator, potential indicator, Bristol recording voltmeter, Thomson recording wattmeter, in a glass case, rheostats, three pilot lamps, generator and exciter switches. Each feeder panel contains the following instruments mounted on the panel: Automatic circuit breaker, station transformer, current indicator, potential indicator, feeder regulator, two lightning arresters, two pilot lamps, double-pole, double-throw concealed safety switch, together with all plugs and receptacles for four generators, so that at any time another generator panel may be added to the switchboard in case the plant should increase another unit. With the exception of the exciter switches the contacts of the switches and receptacles are on the back of the switchboard, only the handles showing in front. The panels are so arranged that each or all of the feeders can be connected to any of the

generators or transferred from one to another by making the proper connections with the plugs and cables from feeder to generator before throwing the switch, thereby causing the least possible flicker of the lights during the transfer from one generator to another. All wires from the machines to the switchboard are run under the floor and brought up back of the switchboard through conduits. The circuits leave the switchboard from the back, passing through choke coils to the lightning arresters and then out through the side of the building to the wire frame. The switchboard complete was furnished by the General Electric Company, and the current and potential indicators are their well-known inclined coil type. The feeder regulators are of 3.5-kw capacity, of the M-R type, wound for a variation of 80 volts. The regulator cases are filled with oil. No fuses at all are used on the feeder panels, the automatic circuit breakers answering every purpose.



A TRANSFER STATION—THE LAST MULE CAR GOING IN.

The switchboard for the two-phase power system is made of white marble with polished brass trimmings. It is made in three sections, two for machine and one for feeder switch and instruments. Each machine section contains a potential indicator, two current indicators, one four-pole plunger type of non-arcing switch, rheostats, and a pilot lamp. The feeder section contains one switch, the same as that used on the machine section, two Thomson recording wattmeters, and a ground detector. The switchboard was built by the Westinghouse Electric & Manufacturing Company, and with the exception of the wattmeters and ground detectors the instruments are of their well-known form, enclosed in plate-glass cases, with polished brass trimmings.

The incandescent feeders are protected by the improved type L station arresters, and the power system by the new type Wirt short-gap arrester, made by the General Electric Company. Wurt's non-arcing arresters are used on the pressure wires.

The wire used in the station wiring was Okonite and General Electric rubber covered, on porcelain insulators. Porcelain bushings screwed to the floors and walls are used wherever the wires pass through wood.

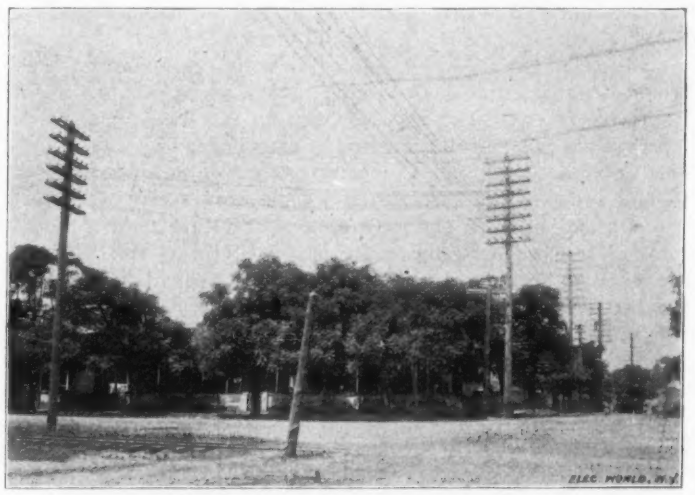
There are three arc circuits for street and two for commercial lighting. The three street circuits supply 120 lamps of 9.6 amperes, and are usually run from the Brush machine, by the multicircuit attachment. With the exception of three, all the street lamps are mounted on the top of poles, using a pole fixture and hood.

There are 6500 incandescent lamps, several pressing irons in clothing factories, a large number of fan and sewing-machine motors, and some heating and cooking apparatus attached to the incandescent system. In planning the distribution of the incandescent system, the city was laid out in seven districts. A set of feeders was run to the centre of distribution of each district. These feeders have an average carrying capacity of 800 16-cp, 55-watt lights each, with a loss not exceeding 4 per cent. From this centre of distribution a set of pressure wires was run back to the switchboard. These are of No. 12 hard-drawn copper, with a triple-braid weatherproof insulation. They pass through choke coils and are connected to the station transformer supplying the potential indicator and pilot lamps on the feeder panel. As each set of feeders has its own regulator, the correct pressure can always be carried at the centre of distribution.

Since adopting this plan the regulation at the lamps is so close that 3.6-watt lamps running 1 volt above normal give an average life of over 500 hours. The branch mains are of ample capacity to carry all the lights connected to them with practically no drop. The inside wiring is calculated for 1 per cent.

The lines extend on nearly every street and avenue in the city, and are carried on over 1200 poles, varying in heights from 30 feet to 50 feet. They are set from 75 feet to 120 feet apart, and are of cedar, chestnut and cypress. The poles carrying the main route of wires are of cypress, 50 feet long, not less than 10 inches at the top, and most of them 12 inches, gained for ten arms, and set not more than 100 feet apart. They carry eight six-pin arms, and forty-eight wires, including the railroad feeders. This line of poles and wires are set near the middle of the street, as are nearly all the poles and wires in the city, the streets being 100 feet and the avenues 132 feet wide, giving plenty of room for a drive on each side. Poles are set 6 feet deep on straight runs and 7 to 8 feet deep at turns and angles. Poles at turns and angles have double arms, well braced and bolted at the ends. End spans and angles are well guyed with cable and turn buckles. Before setting, the butts, tops and gains of all poles are thoroughly treated with carbolineum compound, a wood preservative made by the Carbolineum Wood Preserving Company, of Nashville, Tenn. The butts are shaved to remove the hard surface of the wood, and the compound applied with a brush while heated to the boiling point. Yellow pine arms are used. These are 3½ x 4½ x 51 inches long for the four-pin and 88 inches long for the six-pin arms. One and one-half-inch locust pins are used. All pins and arms are thoroughly treated with the compound by being dipped in a vat of the boiling carbolineum and left for about five minutes. Experience has proven that the compound fills the wood, acts as an insulator, and prevents much of the leakage of current in wet weather. Nearly all of the old types of small transformers have been replaced by large ones, using one for each block where possible. In the main part of the city a three-wire distribution is used, each transformer supplying one side of the street for each block.

This plan has also been adopted in lighting a suburban district. The General Electric type H transformer is used exclusively on the lighting circuits and the Westinghouse mostly on the power system, for supplying induction motors. This section of the country is subject to the most severe lightning storms and it has been one experiment after another to protect the apparatus. The ordinary lightning arresters are hardly good for more than one season and some have been torn to pieces during nearly every severe storm. Transformers of almost every type have been burned up until this season. This year the new type Wirt short-gap arrester with graphite resistance was adopted and some sixty of them put on trial. These are placed on the end of every branch main and two sets about half way from the centre of distribution to the plant on each feeder. The older types were remodeled and single-



A CORNER ON THE MAIN POLE ROUTE.

pole arresters made of the double-pole type, thus giving them double capacity and reducing the tendency of a short circuit through the case. There are 132 of these which are distributed along the branch mains between the transformers. No transformer is ever placed on the end of a circuit. The circuit is always extended one or two spans, and an arrester connected to the ends, and the transformer coupled in by means of a primary box and a set of choke coils. In nearly every instance that a transformer

has been placed on the end of a circuit it has been burned out in the first storm. The old-style arresters placed on the ends of a circuit are nearly always the ones to short circuit and go to pieces. The grounds for the arresters are made by digging a hole about 2 feet in diameter and 6 feet deep near the pole. The ground wire is securely bolted to a piece of 1½-inch galvanized iron pipe, 9 feet long, which is then driven to within about 2 feet of the bottom of the hole, and the hole filled nearly full of coke. This has been found to work well in almost every instance. Since putting up the new arresters only two or three old-style transformers (without oil) were burned out before they could be exchanged for the new type.

Lights and power are furnished both by meter and contact rates. About 80 per cent. of the incandescent lights are on meter, and over 2500 of them are in residences. Many of the residences are furnished lights on contract rates, the charge being determined by the capacity of the service furnished, without regard to the number of openings in the house. For example, a charge of $5 per month is made for a service that will just supply ten 55 watt 16 candle-power lamps. On the pole is placed a cut-out box which carries two fuses that have been carefully tested and found to carry just ten lights. If more are turned on or larger lamps are used the fuse melts, and the people are left without lights until the next

A Lake in Wildwood Park.

day. In practice this system works very well, and it is a rare occurrence that any house is without light on account of trying to burn too many lights. From time to time tests are made to ascertain the carrying capacity of these fuses. Tests with a meter on such residences show that they use more than actually paid for at meter rates during the winter, and less during the summer months, but that the average rate is not far from the meter rates. It has the advantage of an even income during the entire year, and no high bills and dissatisfaction in the winter, and a saving of investment in transformers, etc. The customer pays for renewal of lamps, and this prevents a waste of the current.

The Columbus Railroad Company operates about 15 miles of passenger and 5 miles of freight tracks, reaching nearly every part of the city and suburbs, and extending to the three parks. There are double tracks almost the entire length of Broad street, which is the principal business street, and from these tracks others extend across the city on every street, except one, from Fifth street to Fifteenth street, inclusive. These tracks are arranged and used as loops, the cars going down on one track on Broad street, thence out Fifth Street to Sixth Avenue, and returning on Sixth Street, and the other track on Broad Street.

At the intersection of Broad and Twelfth Streets, located in the centre of Broad Street, is a handsome transfer station of brick, with stone trimmings, for the use of the patrons of the company. This station contains nicely furnished, well-lighted waiting rooms, equipped with electric fans in summer and heated in winter. Also located in this building are the offices of the company.

The company has nineteen motor cars, eight closed and eleven open, and five trailers. The motor cars are each equipped with two General Electric 800 motors and K and K2 controllers. All the cars are a uniform length of 28 feet over all, and, with the exception of three, are mounted on McGuire trucks, having 33-inch wheels and 3¼-inch axles. The cars have a seating capacity of about forty people.

Quick schedules are maintained on all the lines, and so arranged as to cause a minimum delay in changing from one line to another. The company owns Wildwood Park, located on the belt line, which is one of the prettiest parks in the State. It has a large pavilion for dancing and entertainments, a baseball ground and a large lake, with bath and boat houses. Another line runs to North Highlands Park, where a high class of entertainments of all kinds is provided, including summer opera, vaudeville, etc., during the summer, and at all seasons the natural scenery of this park is unsurpassed.

The company owns Lincoln Park, where a handsome pavilion has been built for the colored people, located about 2 miles out, at the terminus of the Rose Hill line.

All of the track is of the best construction of 56-pound T rail, laid on standard cross ties. The joints are bolted with six bolts to each rail and well bonded with double bonds of 0000 copper. The curves and crosses are of special construction. The trolley is of No. 0 hard copper, and is carried by bracket construction.

Circuit breakers are used dividing the trolley into six sections, each section being fed by a feeder direct from the power station. Copper return wires of about half of the cross section of the feeders are used, which are connected to the track at various places. The track is also well grounded. Wurts lightning arresters are used on the lines and feeders and General Electric arresters in the station.

The freight tracks extend into the yards of the various railroads, and freight cars are handled to the doors of the merchants or in the yards of the mills. The freight tracks are connected to the passenger tracks, and freight cars can be taken over any of the passenger tracks, though the freight business is at present handled by two steam dummy engines.

Some Cheap Ash Cars.

BY JAMES F. HOBART.

I recently noticed some cars for ashes and dirt that had evidently been rigged up at very slight cost. They were not motor cars, but were used as trailers only. The cars in question were merely old horse cars cut down to the bottom of the windows, and sheathed inside with sheet iron on the lines indicated in the engraving, Fig. 1, at *c c*. The bottom of the car was also ironclad by covering the ordinary floor with sheet iron, and letting the iron on the sides come down upon the bottom.

A capping of 1½-inch ash is broken around the sides of the car where they are cut off. This capping, shown at *a a*, stiffens the car by making fast and tying together the timbers that were cut away.

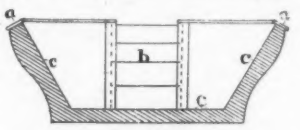


Fig. 1.—Section of Ash Car.

The capping is put on at right angles to the inside lining, and is mitred at the corners. The doorway *b* is left as in the car before the change was made, and the addition of strips of plank at either side of the door permits some "tail boards" to be placed across the doors to keep the ashes or dirt from falling upon the platform.

When it is required to shovel out the contents of one of these cars, the "tail boards" are easily pulled out, and the man begins to shovel from the platform at either end, working into the body of the car as he progresses. It would not cost very much to put traps in the bottom of these cars, so hinged as to oper downwards. The unloading could be greatly facilitated by this arrangement, and when the ashes had to be placed in a cart or a boat, an elevated track could be easily arranged to make very short work of the unloading.

Churning by Trolley.

A story is told in a Wichita, Kan., paper of a unique idea in utilizing trolley cars for churning purposes. According to this authority the owners of cows in the vicinity of the packing houses in that city set the churn on the front end of a car. One round trip, it is said, is sufficient to do the work, and the motorman takes the buttermilk in payment for the mechanical agitation imparted to the cream.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES FOREIGN AND AMERICAN JOURNALS

COMPILED FROM

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Heating of Magnet Coils. GIRAULT. *L'Ind. Elec.*, Aug. 10.—A short article deducing from Esson's formula some comparatively simple formulas for direct application in specific cases Esson's formula is that the rise in temperature, in centigrade degrees, is equal to a co-efficient (for which he gives the value 355), multiplied by the power dissipated in watts and divided by the cooling surface in sq. cm.; it appears that this latter surface is taken as the outside surface of the coil itself. The present author obtains an expression for the final temperature of a coil through which a constant current passes; for finding the current as limited by a certain rise in temperature, and for finding the final temperature for a constant voltage at the coil.

Armatures with and without Teeth. v. DOLIVO-DOBROWOLSKY. Lond. *Elec.*, Aug. 20.—A translation, with the illustrations, of the article abstracted in the *Digest*, Aug. 21.

Effect of the Form of the Voltage Curve on the Hysteresis Loss of a Transformer. FLEISCHMANN. *L'Eclai... Elec.*, Aug. 7.—An abstract of the article which was noticed in the *Digest*, June 19.

Dynamo Reversals of Polarity. COMSTOCK. *Amer. Elec.*, Sept.—A case is cited of two electric railway power houses feeding entirely different roads, each power house having a single generator, one of whose terminals was grounded, the other terminal going to the respective trolley wires; one had a negative trolley and positive rail, while the connections of the other were the reverse; when one power house undertook to borrow from the other by changing its connections, it resulted in placing the two dynamos in series across a short circuit, the polarity of one of the machines having been changed. The writer believes that accidental causes will not always explain the reversals of dynamo polarity; he considers that if the magnetizing force is suddenly removed from a machine, the molecules in swinging back will, through their magnetic momentum, be carried past their normal neutral position, thus slightly reversing the polarity.

Stopping Motors. POOLE. *Amer. Elec.*, Sept.—Criticising a previous communication, it is stated that all automatic starting boxes for motors are so constructed that opening the main switch releases the rheostat arm and allows it to cut in the resistance, the latter operation necessarily following the opening of the switch; if the starting box resistance in an armature circuit should be thrown in before opening the main switch, the counter E. M. F. of the armature would not tend to neutralize the inductive "kick" of the field.

Dynamo and Motor Design.—Elec. Rev., Aug. 25.—A reprint, in abstract, of the article which was abstracted in the *Digest*, Aug. 7, describing the experiments of Fynn.

Design for Small Motor. POOLE. *Amer. Elec.*, Sept.—Instructions, accompanied by working drawings, for making a one-quarter hp direct current motor with ring armature. The article also gives the windings for battery service of two small motors whose construction was described in preceding issues.

Practical Method of Generator Variable Overcompounding. HUTCHINSON. *Amer. Elec.*, Sept.—A simple and practical method for applying a shunt to the compound winding of a generator in order to make the compounding variable.

Testing Dynamos.—Amer. Elec., Sept.—The calibrated motor and transmission of dynamometer methods are described; a simple form of flexible coupling is illustrated for use in these tests.

LIGHTS AND LIGHTING.

Universal Switch.—L'Ind. Elec., Aug. 10.—An illustrated description of a form of switch devised by Leroy for lighting or extinguishing a batch of lamps from any one of more than two different switches; the ordinary three-point switch has been in use for this purpose, but is limited to being placed at only two places; in the present system any number of switches can be used and at each one the lamps may be turned on or off. The switches and connections are shown in the cut on next column, and it will be noticed that only two wires are required between the switches; the switch is practically a commutator.

Ship Lights.—L'Elec, Aug. 7.—A description of a system suggested by Cadiou for operating additional red and green lights to show the direction in which a vessel is going

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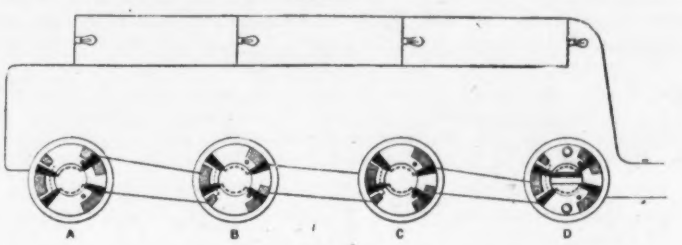


Double End Switch Arrangement. PUTNAM. *Amer. Elec.*, Sept.—Description of an arrangement whereby incandescent lights may be independently turned off or on from two points; (there appears to be something wrong or omitted in the illustration).

POWER.

Calculating Currents for Polyphase Transmission. VOGEL. *L'Eclairage Elec.*, Aug. 7.—A mathematical article in which he deduces some rather complicated formulas for the currents in a three-phase system of circuits the connections being according to the star system; the formulas themselves are not discussed, but it is remarked that contrary to the opinion, often given without proof, it is possible to transmit by means of three wires, alternating currents the differences of phases between which differ from 60° to 120°.

Three-Phase Transmission.—L'Ind. Elec., Aug. 10.—A brief description of the exhibition plant in which power is transmitted from Tervueren to Brussels, and which is said to be one of the interesting features of that exhibition. The distance is 12 7 km, the power is 160 kw and the voltage 4300, with a period of 50; the triangle or delta system of connection is used, as it has advantages when motors and lights are combined on the same wires; the efficiency between the shaft of the generator and that of the motor is 73.5 per cent. A feature of interest is said to be the simplicity of the apparatus and the ease with which it is handled and the motors started.

Large Power Plant at Trollhaettan.—Elek. Zeit., Aug. 5.—A note stating that this large plant in Sweden (where the Laval electric furnace is to be used) is nearing completion; the first application will be for producing calcium carbide, which is to be followed by the production of other chemicals, metals and alloys; about 25,000 horse-power will be used by the company itself, and 50,000 horse-power will be sold to other consumers; the total power of the falls is 220,000.

Selection of Alternating-Current Power Generators. RAYMOND. *Amer. Elec.*, Sept.—For transmissions up from six to ten miles it is best to use generators of voltage up to 4000 volts, and for longer distances generators of low voltage in connection with transformers stepping up to 10,000 volts and over. In order to provide against a discharge from a coil on an alternator armature to the inside of the protecting shield, the writer placed blocks around the shunt at intervals so as to make fireproof sections, lined inside of the shield with mica and asbestos, and packed closely about every coil with shredded asbestos; instead of this makeshift method it is recommended that all metal be kept at least 1 1-2 inches from the coils except in the slots; the use of hard rubber rings between the collectors of 2 1-2 and even 3 inches greater radius than the collector ring is considered desirable. The writer considers that properly insulated high-voltage machines giving a saw-tooth wave will ordinarily be satisfactory if the line and system are guaranteed free from resistance; if, however, there is water power to any sufficiency he believes that low-voltage generators and step-up transformers will prove more satisfactory, the regulation being much closer and the practical operation more satisfactory. If generators are not run in parallel, individual exciters may be used, and in this case the greater sensitiveness of compound over shunt generators will prove of advantage in the generating station. For synchronous motors a shunt exciter is excellent; if the generators are run in parallel a common exciter will prove most convenient, for, if a heavy pull comes on a general increase of

machine pressure can be obtained at once by simply increasing this exciter voltage, separate regulations being obtained by means of the main field boxes.

TRACTION.

Law of Maximum Work for Traction Accumulators. Fitz-Gerald. Lond. *Elec. Eng.*, Aug. 20.—He endeavors to show by a simple calculation how to determine, from theoretical or practical data, the distance through which any weight of a given accumulator could convey itself only, and also the conditions of maximum useful work; he shows with the aid of a diagram that there is a point at which the useful work will be a maximum; at this point the ratio of the maximum useful work to the theoretical maximum is 0 25 and occurs when the weight of the accumulator is half the total traction weight, the distance traveled being half that through which any given weight of accumulator would convey itself; he shows that the weight of the accumulator increases at a higher ratio than the useful work.

Zermatt Gorner-Grat Railway.—Lond. *Elec.*, Aug. 20.—A brief description from the Lond. *Engineer.* This line in the Alps is under construction and is to be opened in July, 1898; the trolley system is to be used; the average grade is 1 in 6.5 and the maximum 1 in 5, rack and pinions being necessary for the whole distance of 6 miles; the line follows the contour of the mountain sides; the current is generated by a waterfall; there are three turbines of 350 horse-power each; they generate the current at 5000 volts, which is transformed down to 500 volts at four points along the route; the motor car will carry 50 passengers and will push another before it carrying 60; from September to July the railway and machinery house will be buried in snow for most of the time.

Leipzig Street Railway. Eisig. *Elek. Zeit.*, Aug. 5.—A long, well-illustrated description of this system of street railways, in which the usual trolley system is used.

Electric Cabs.—Lond. *Elec. Eng.*, *Elec.*, and *Elec. Rev.*, Aug. 20.—A description, with illustrations in the two former journals, of the Bersey cab, of which a number are in use in London; the total weight is 30 cwt. and the weight of the accumulators is 14 cwt., there being 40 cells having a capacity of 170 ampere hours at a rate of 30 amperes; both chain and gear reduction are used.

Electric-Railway Operation.—Amer. Elec., Sept.—The single-motor equipment is considered and the claim made that for interurban service a single equipment is much superior to a double one. On such lines there is practically but one speed and therefore a single running notch suffices. A single equipment takes less current than a double equipment of the same capacity; it is very rare that the motors of a double equipment act together, it being easily possible for one motor to be heavily overloaded and the other lightly loaded, and the power wasted in the skidding of the wheels greatly detracts from the output of the double equipment; in hill climbing the single equipment has the advantage, for as the grade increases the disadvantage of the double equipment above referred to becomes accentuated. A motorman running a single equipment should learn the art of drifting, which is stated to be by no means so simple as it appears on paper.

Railways with Stationary Accumulators. Schroeder. *Elec. Eng.*, Aug. 26.—A reprint of the translation noticed in the *Digest*, Aug. 21.

Boston Subway.—West. Elec., Aug. 28.—A brief, illustrated description of the subway on Tremont Street, part of which is now finished.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Theatre Plant.—Lond. *Elec. Eng.*, Aug. 20.—An illustrated description of the plant at the Grand Theatre, Fulham, which is one of the latest additions to the suburban theatres in London.

Brussels.—L'Ind. Elec., Aug. 10.—A very brief description of the three stations in that city.

Strassburg Central Station.—Amer. Elec., Sept.—A long, illustrated description of the three-phase central station at Strassburg, Germany. The distribution is from transformer sub-stations, which in most cases are in underground chambers; triple-concentric conductors in a lead-covered sheath armored with iron tape are used; a storage battery auxiliary for an electric-railway service is employed, which is charged at the time the least current is used and furnishes current when the consumption is greatest; it is stated that experience with plants of this size has shown that the use of the storage battery as a so-called "buffer battery" to take care of fluctuations is not of primary importance, the main function of the battery being rather to contribute a supply in the morning and evening hours at the time of the greatest railway traffic. The generators for the street-railway service consist of two 200-hp 500-volt compound-wound machines and two 400-hp 500-volt shunt-wound machines; the three-phased generators are of several different sizes, enabling gradations of 200, 400, 600, 800 and 1125 horse-power to be obtained. In connection with the distributing system is a fault-testing system, which automatically indicates the location of a fault when it occurs; this same system also enables the voltage at different points of the secondary system to be tested, a signal being sounded when the voltage falls below or above fixed limits.

Shoreditch.—West. Elec., Aug. 28.—A reprint of some of the illustrations, accompanied by a description, of the article recently noticed from the London journals.

Charging for Inductive Power Load.—Amer. Elec., Sept.—Referring to a discussion at the Eliot meeting of the A. I. E. E. on the lowering of the capacity of alternating-current generators carrying a power load, it is stated that the case corresponds exactly with the conditions which the Wright system of charges was devised to meet in direct-current work, and which system would seem to be directly applicable to alternating-power work. By means of a properly constructed meter of the Wright system, abnormal rushes of current upon starting up or when there is a tendency to get out of step, would not be registered.

WIRES, WIRING AND CONDUITS.

Interior Wiring.—Lond. *Elec. Rev.*, Aug. 20.—A reprint of the recent institution rules, accompanied by an editorial discussion; there is also a criticism by a correspondent.

Interior Wiring.—Amer. Elec., Sept.—Iron-armored conduit installations are considered in the present issue; the different fittings are illustrated and described and instructions for putting up and drawing in are given.

Fuse and Circuit Breaker. Stine. *Amer. Elec.*, Sept.—It is stated that if a given set of conditions are rigorously adhered to, any fuse will blow with extreme regularity; this regularity, however, is interfered with by a variety of conditions, among which are the length of the fuse, the oxide film or coating, the condition and mass of the terminals, contact with foreign substances, and whether the fuse is exposed or open freely to the air. The lengths of fuses prescribed by the underwriter's code might be lengthened 25 per cent.; by employing ribbons for large fuses the oxide film is relatively weaker and less apt to retain the molten metal without rupture of the circuit. According to the writer's experiments fuses in a tube packed with sand or other non-conducting substances possess a striking weakness over open fuses in that, being supported over their length, the metal melts and even a very thin film of oxide suffices to prevent rupture. In summing up, it is stated that a fuse of the proper length and exposed to the air, properly placed in its receptacle and mounted on copper terminals, will do excellent service, both as regards regularity and reliability, except where small time constants may be of importance; constructed as it may be, however, it will always have the weakness of a large time constant and, except for abnormally excessive currents, will therefore be slow in opening the circuits. For closet work the fuse is an excellent device and it will not be wise to replace it with the circuit breaker; on the other hand it should be excluded from the switchboard. The evidence from tests of a large number of makes of circuit breakers is that the time of their opening does not vary more than 3 to 5 per cent. and is practically the same for creeping and impulsive currents, while their time constant is a minute fraction of a second.

Circuit Breakers vs. Fuses. Bevan. *Amer. Elec.*, Sept.—He defends the circuit breaker from an attack by a writer in the preceding issue. It is maintained that in a railway power station a fuse has no place except on lighting circuits.

ELECTRO-PHYSICS AND MAGNETISM.

Counter E. M. F. of the Arc. Blondel. *L'Elec.*, Aug. 14, and *L'Ind. Elec.*, Aug. 10.—A reprint of an Academy note describing some interesting experiments, in which he endeavored to determine by a new method of measurement whether there is a true counter E. M. F. of the arc; this consisted in breaking the current periodically for one six-hundredth of a second, and at frequent intervals, and connecting the terminals of the arc during those moments to the terminals of a galvanometer; these connections were made by a revolving commutator, of which an illustration, together with a diagram of connections, is given; a 70-volt battery was the source of current and a resistance was placed in series with the lamp; the arc was quite stable during the test. In order to see how a resistance would act under similar circumstances the test was repeated when a dead resistance was placed in the arc, all other conditions being the same. The results of the test are given in a table showing the reading; a battery of 2.5 volts was also inserted in the galvanometer circuit as a means of obtaining the values of the deflections. The result showed that the deflections given by the 2 5 volts were very large as compared with those given by the arc alone; the latter followed no systematic law and may be attributed to experimental errors; but assuming that they are not errors, he calculates the voltage of the largest of the deflections and finds that it does not exceed 0.15 volt as the possible counter E. M. F. of the arc; this is far from the 20 or 30 volts which has often been claimed. He concludes that it is now definitely established by these tests that the arc acts like a resistance, and has no counter E. M. F. at all comparative with the observed difference of potential.

Heat of the Electric Spark. Kaufmann. *Proc. Lond. Phys. Soc.*, July; abstracted from the *Wied. Ann.*, 60, p. 653.—He describes experiments; the discharge potentials varied between 6800 and 16,000 volts; the heat of the spark was found to be only about one-twelfth of the total heat in the circuit; for fairly low potentials the total heat varies with the square of the discharge potential, while the heat of the discharge varies as its cube; the heat developed between brass terminals in only 0.54 of that between zinc terminals.

Spark Discharge. Pettinelli. *Nuovo Cimento*, July; noticed briefly in the Lond. *Elec.*, Aug. 20.—He studied the following phenomenon: If a

Leyden jar discharge is sent through a spark gap over which a piece of thin tinfoil is laid, a shower of sparks passes radially from each of the balls through the foil, carrying particles of the tin with it; he used a Tesla coil; an interesting feature in the phenomenon was that apparently a high-tension effect was produced from a low-tension spark gap.

Diagrams of Instantaneous Voltage in Alternating-Current Circuits. ALLEN. Lond. *Elec.*, Aug. 20.—The method of showing the relations in a circuit by plotting resistance as abscissas and potentials as ordinates has generally been applied to continuous currents only; he shows that it may also be applied to alternating current, by plotting the instantaneous voltages as ordinates and the impedances as abscissas; two large diagrams are worked out; various forms of models can be constructed to illustrate these variations of potentials.

Spherical Conducting Shell. WHITEHEAD. *Phil. Mag.*, Aug.—A reprint of a mathematical Physical Society paper discussing the effect of a spherical conducting shell on the induction at a point in the dielectric outside due to an alternating current in a circular circuit in the dielectric inside, the axis of the conductor passing through the centre of the shell.

Dielectric Constants. STARKE. *Wied. Ann.*, No. 8; noticed briefly in the Lond. *Elec.*, Aug. 20.—Some time ago he described a method of measuring, by immersing the bodies in a mixture of two liquids, in whose capacity the introduction of the solid produced no difference; he now finds that by employing high-frequency currents of a frequency of six millions, the range of non-conducting liquids is very considerably increased; alcohol can then be used and the fragments of the solid can be much smaller.

Propagation of Electric Waves. RAYLEIGH. *Phil. Mag.*, Aug.—A short paper on the propagation of such waves along cylindrical conductors of any section; for some scientific purposes the conductivity may be considered perfect, and under this condition the problem is so much simplified that important extensions may be made in other directions.

Attenuation and Reflection of Waves. BARTON. *Phil. Mag.*, Aug.—A reprint of a Physical Society paper on the attenuation of electric waves along wires and their reflection at the oscillator; he used the method of absorption by a terminal bridge for determining the attenuation.

Dark Light.—Proc. Lond. Phys. Soc., July.—Abstracts of five articles from the *Comptes Rendus* discussing the subject of the dark light which Le Bon claims to have noticed; it includes three articles by Le Bon himself.

Magnetic Deflection of X-Rays. STOKES. *L'Eclairage Elec.*, Aug. 7.—A reprint of an Academy note. In a recent note by Metz results were described which can be explained only on the hypothesis that in an extreme vacuum the X-rays are deflected by a magnet, or that the cathode rays can pass through the walls of a Crookes tube; the present writer offers another explanation which he thinks is the correct one. Everything tends to show that X-rays are a transverse agitation of the ether; he also believes that cathode and X-rays have completely different natures; admitting this, the explanation of the phenomena observed by Metz is very simple; when the air in the interior is nearly at atmospheric pressure the fluorescence on the screen is due to X-rays, for as Lenard has shown, the cathode rays are stopped by the air; the rays which produce the fluorescence would therefore not be deflected by a magnet; on the other hand if the pressure is very low the cathode rays consisting of the molecules projected from the surface, which is a cathode by induction, are capable of reaching the screen, the fluorescence being principally due to these rays; it was found that the rays in this case could be deflected by a magnet.

Interference and Electrostatic Deflection of Cathode Rays. JAUMANN. *Phil. Mag.*, Aug.; abstracted from the *Wiener Berichte*, July.—He describes an experiment which shows the interference of cathode lights; he discusses electrostatic deflection in connection with his theory.

Haziness in Radiographs. VILLARD. *L'Eclairage Elec.*, Aug. 7.—A reprint of an Academy note. Radiographs are often found to have a hazy appearance, particularly when the objects are thick; he describes experiments which seem to show that this haziness is not due to the action of the rays which pass through the objects; it seems to be due to a sort of fluorescence of the surrounding air.

Action of X-Rays on the Temperature of Animals. LECERCLE. *L'Eclairage Elec.*, Aug. 7.—An abstract of an Academy note in which he gives the results of experiments made on animals; he found that the cutaneous and rectal temperatures are affected in the same way and that they fall at first, while half an hour after the test they rise again to the original.

Transformation of X-Rays by Metals. SAGNAC. *L'Eclairage Elec.*, Aug. 7.—A reprint of an Academy note describing experiments. If a beam of X-rays falls obliquely on a metal sheet below which is placed a photographic plate, the latter will be found to be affected; such an action was obtained by gold, silver, zinc, copper, lead and tin, while aluminum was inactive. From experiments made in this direction he concludes that different metals exert an absorption effect on X-rays, and the surface of the metal emits new rays which are much more difficult to transmit than those from mica and aluminum; these new rays are also transformed by alumiuum; the luminescence of the metals on which X-rays are directed, therefore, furnishes a new series of radiations; these could then again be transformed, and he believes that by successive transformations the interval separating the X-rays from the ultra violet rays could be filled.

Discharge of Cathode Rays. BATTELLI and GARBASSO. *Nuovo Cimento*, July; abstracted briefly in the Lond. *Elec.*, Aug. 20.—They showed that cathode rays acquire the discharging properties of Lenard and Röntgen rays when they are filtered through aluminum or glass, but that the change in the property is not due to the passage but to the change in the medium surrounding the rays; the proof is said to be conclusive; the discharge properties of Lenard rays are, therefore, like those of X-rays, due to the ionization of the air.

Discharge of Electrified Uranium in Air. BECQUEREL. *Proc. Lond. Phys. Soc.*, July; abstracted briefly from the *Comptes Rendus*, 124, p. 800.—He discusses the law of the discharge; some salts put out of reach of all radiations more than a year ago still go on without apparent weakening emitting rays which can affect a photographic plate.

Röntgen Rays.—Proc. Lond. Phys. Soc., July.—A large number of abstracts of various articles, too numerous to be abstracted here; many of them are abstracts of articles which have been already noticed, although, as a rule, more briefly; they are almost entirely from French sources. The same number contains numerous abstracts of other articles on vacuum tube phenomena and closely allied subjects.

Soft Steel for Electromagnets. ABT. *Wied. Ann.*, No. 8; noticed briefly in the Lond. *Elec.*, Aug. 20.—He made a comparison between two exactly similar cores weighing 47 kgr, one of soft steel and the other of soft iron, and obtained 0.98 to 1.04 for the ratio of the permeabilities of the former to the latter and 1.2 to 1.3 as the ratio of the permanent magnetism.

Tortion and Magnetization of Nickel. CANTONE. *Proc. Lond. Phys. Soc.*, July; abstracted from *Nuovo Cimento*, 4, p. 110.—A description of a repetition, with additional precautions, of some of Nagaoka's experiments.

Terrestrial Magnetism. ESCHENHAGEN. Lond. *Elec.*, Aug. 20.—A short notice of a Berlin Academy note on certain small variation of the earth's magnetism which he had detected for the first time; their cause is uncertain, but he believes it to be of atmospheric origin; the rapid fluctuations can be detected by observing the induced currents in a large coil, which eliminates disturbances of a long period.

Inductance and Capacity.—Amer. Elec., Sept.—The relative actions of inductance and capacity are illustrated with reference to the exhaust pipe of a steam engine; if the throttling valve in the exhaust pipe is partly closed, the exhaust will, of course, be choked; if now the exhaust pipe is given an opening into the condenser, the effect of this choking will be overcome by the draft of the condenser and the exhaust thus be made to act as it did before the pipe was throttled. An inductance produces in an electrical circuit in which the current is increasing an effect similar to that of the throttling valve, while a capacity has then an action similar to that of the steam condenser; when the current decreases in value the analogy still holds, if the action of inductance is compared to that of a condenser and capacity to that of a throttling valve. Another way of looking at the subject is to consider that when a current is increasing in value in a circuit containing an inductance, a counter E.M.F. is set up by the inductance which acts against the impressed E.M.F., and this counter E.M.F. may be considered to set up a counter current which neutralizes part of the main current; if the current is decreased in value the inductive E.M.F. is in the same direction as the impressed E.M.F. and the inductive current is added to the main current; the effect is that the main current arrives at its maximum value later than it would in a non-inductive circuit, and also dies out later, thus causing the current to lag behind the impressed E.M.F.; on the other hand, when a current is increasing in value in a circuit containing a condenser, as the E.M.F. rises the two sides of the condenser become unbalanced, which sets up an additional flow of current, the unbalancing corresponding to an additional voltage in the circuit instead of a counter E.M.F., as in the case of an inductance; when a current is decreasing in value the two sides of a condenser become unbalanced in an opposite direction and discharge into the circuit, thereby assisting the fall of current, the action again being the reverse of that of inductance. If a capacity is placed in a circuit containing inductance and has such a value that the current which it tends to set up balances the current which the inductance tends to set up, the circuit will act toward alternating currents in precisely the same manner as toward direct currents.

Calculating Joint Resistance. HOLDEN. *Amer. Elec.*, Sept.—A kink in the calculation of joint resistance is given, the rule being as follows: "Multiply all the resistances together; divide this product by each resistance in turn and add the quotients; divide the product of all the resistances by the sum of the quotients, and the results will be the joint resistance of the lines."

Lifting Magnets.—West. Elec., Aug. 28, and *Elec. Eng.*, Aug. 26.—An illustrated description, from the *Iron Age*, of the Wellman magnet for lifting steel plates in a factory; the proportions are given, including good working drawings. It is claimed that there is no more danger of dropping the load than with the older form of support, and that the convenience and saving in time more than compensate for the cost.

Cathode Rays.—Elec. Rev., Aug. 25.—A reprint of translations of two French Academy papers, one by MALTEZOS on cathode rays and some phenomena in vacuum tubes, which was noticed in the *Digest*, June 19 and July 3, and the other by DESLANDRES on a new property of cathode rays,

which was noticed in the *Digest*, June 5 and 19; (in the title of the present translation the word "complete" should have been "complex," thus changing the meaning considerably).

Röntgen Rays.—Amer. Elec., Sept.—It is recommended that in view of the danger that may attend the application of Rontgen rays to the human body, the laws which prevent unauthorized persons from practicing the physician's art should be extended to include the application of Rontgen rays; licenses, however, might be granted to competent non-medical experts in this branch, as the manipulation of the generating apparatus requires considerable skill.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Gases. Wiedemann and Schmidt. *Wied. Ann.*, No. 8; noticed briefly in the Lond. *Elec.*, Aug. 20.—The electrolysis of gases does not follow the simple law of liquid electrolytes; in their researches they used a battery of 1000 accumulators; the chief gas examined was hydrochloride acid; the results showed that chlorine was formed at both the electrodes, about 31 per cent. of the quantity required by Faraday's law at the anode and 53 per cent. at both together; it therefore appears that no electrolysis in Faraday's sense takes place.

Accumulators. Blanchon. Lond. *Elec.*, Aug. 20.—A translation of the paper which was abstracted in the *Digest*, Aug. 7.

Thermo-Electric Battery. Anthony and Reed. *Amer. Elec.*, Sept.—Anthony, replying to a communication by Reed in a preceding number, says that in the latter's list of possible reactions by which the oxidation of the carbon in the Jacques cell to carbon dioxide by the electrolyte may take place, he omits the reduction of Fe_2O to Fe O, and entirely ignores the effect of the oxygen forced into the cell at the other electrode. Anthony contends that with oxygen present ready to combine with the reduced ion, that ion is never actually free, but simply passes from one molecule of oxygen to another, and that we have no right to base an assumption upon action at one electrode alone. In the sum total of chemical action the energy which is evolved within the Jacques cell is more than sufficient to account for the electrical energy developed, and therefore the cell would, if sufficiently protected by non-conducting coverings, keep itself hot after action has once commenced. While it may be true that a certain amount of energy is necessary to cause the decomposition of an electrolyte with the aggregation of the ions into physical masses, it by no means follows that the same energy is required when some other substance stands ready to seize upon the molecules of the ion as fast as they are liberated, forming a new compound with the evolution of energy. He believes that when the Jacques cell is fully investigated it will be found that energy also comes from chemical action within the electrolyte, which is partly absorption of oxygen from the air, and that this action, whatsoever it may be, will finally exhaust the electrolyte, which will then have to be renewed as in any other battery. Replying to Anthony, Reed says his contention is that the Jacques cell does not constitute a galvanic element, and that there is no electrolyte in the cell which can undergo decomposition without absorbing external heat, since the total energy of combustion of the carbon oxidized in the cell would not be sufficient to cause decomposition of any compound in the cell without absorption of external heat. While he admits that there must be binary decomposition of the electrodes, yet the combination heats of all the substances present show that the energy is not within the cell. While the oxidation of the carbon furnishes energy enough to account for the electrical energy developed or to keep the cell hot, it is a fatal mistake to suppose that it furnishes enough to decompose anything that may be in the cell, as there is no relation between these two quantities. The electrical energy, as claimed by Jacques, is only about 80 per cent. of that contained in the carbon, while that required for any possible chemical reaction exceeds that contained in the carbon. Referring to Anthony's claim that the chemical action may be a reduction of Fe_2O to Fe O, it is stated that this reduction requires 12.6 units of energy more than the carbons contain. There are several other reasons why this is not possible, for carbon at the temperature of the Jacques cell does not reduce ferric oxide, as such is not soluble in alkaline hydrates at any temperature, but dissolves only by changing to an alkaline ferrate; E. Thomson has found by experiment that metallic iron and not ferrous oxide is formed in the Jacques cell at the cell wall.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Potentiometer. Fry. Lond. *Elec. Rev.*, Aug. 20.—An illustrated description of a wide-range instrument designed by Thiermann; it is intended especially for the calibration of voltmeters but can also be used for current or resistance measurement; it is claimed to combine simplicity with a wide range and high degree of accuracy; instantaneous measurements can be made between 200 and 0.0002 volts with an error of less than half a per cent. The principle of the instrument is said to be that a galvanometer is connected in series with a large resistance and the E. M. F. to be measured; if the voltage is high a shunt resistance is placed across the galvanometer; a diagram of the connection is given, but the description is not very clear.

Ballistic Galvanometer in Theory and Practice. Crapper. Lond. *Elec. Eng.*, Aug. 20.—The first of a series of articles discussing the subject of ballistic galvanometers; owing to the increasing importance of examining iron and steel for magnetic qualities at steel works, such galvanometers have now come into use frequently at such works; this description is intended for those in charge of such works.

Registering Ampere and Voltmeters. Chauvin and Arnoux system. *L'Elec.*, Aug. 7.—An illustrated description of this portable instrument, which consists of the usual form of galvanometer used in the Weston instruments and a recording drum, revolved by clockwork.

Capacity Determination by the Balance. Von Lang. *Wied. Ann.*, No. 8; noticed briefly in the Lond. *Elec.*, Aug. 20.—A description of an approximate method for estimating capacities by weighing; the method is based on the difference of phase produced by a condenser in the circuit, subject to induction from an alternating current.

Brightness of Daylight. Vogel. *Phil. Mag.*, Aug.; abstracted from the *Wied. Ann.*, June.—The abstract contains results of a series of observations by a method which he describes; they were made in Berlin in the month of January in very variable weather and showed the enormous differences in daylight in winter; the results are as follows: at 3 P. M., strong fog, 2.3 meter candles; at 2 P. M. slight fog, 79.59 m. c.; at 2 P. M. gray sky, fog, 89.55 m. c.; at 2 P. M., gray sky, fog, 55.54 m. c.; sunny day, clear, somewhat misty, 394.5 m. c.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Submarine Telegraph Recorder. Rossel. *L'Eclairage Elec.*, Aug. 7.—In the continuation of his serial on submarine telegraphy he gives a well-illustrated description of the Ader photographic recorder, which has been referred to a number of times in these columns.

Recent Progress in Telegraphy. Tobler. *L'Eclairage Elec.*, Aug. 7.—A long abstract of his recent article describing the Dejongh duplex system, an application of the Baudot relay, and other recent improvements.

Hughes Transmission with Baudot Relays. Tobler. *Elek. Zeit.*, Aug. 5.—A German translation of his recent article in the *Journal Telegraphique.*

American Telephone Practice. Miller. *Amer. Elec.*, Sept.—Switchboards for grounded line exchanges are described and illustrated, the type used in small exchanges being considered in the present installment of the series. The drops in a board of this type are stated to be usually wound to a resistance of about 80 ohms, unless designed for multiple or bridged telephone lines, in which case the resistance of the drop is the same as that of the ringer coils of the telephone instruments on the lines, usually 1000 ohms.

Special Telephone Connections. Connaughton. *Amer. Elec.*, Sept.—Connections between two telephones are illustrated whereby conversation from one to the other may be carried on without having to call up the central station to make connections, at the same time permitting the central to call up while the telephones are thus in use. An individual line is run between the two telephones and an extension bell installed at each station; ordinarily the central will ring the telephone bell and either station signal the other by means of an extension bell; when the two stations are talking the telephones are cut out of the central circuits and the extension bells cut in.

A Peculiar Phenomenon. Torrance. *Amer. Elec.*, Sept.—A case is related where during a storm a man using a telephone was badly shocked by a discharge of lightning; it was subsequently found that the diaphragm of the telephone had been pressed during the discharge against the magnet core and coil, and the inside rim of the hard rubber piece, with such force that it conformed exactly to the shapes of these different parts; the pressure was uniform, since the diaphragm was not warped or dented in the least, but took the exact shape of every part against which it bore.

Dynamo Bell Ringing. Lee. *Amer. Elec.*, Sept.—A description, with illustration, of a circuit is given whereby electric bells may be run from a dynamo circuit and automatically switched on to a battery circuit when there is no current in the former.

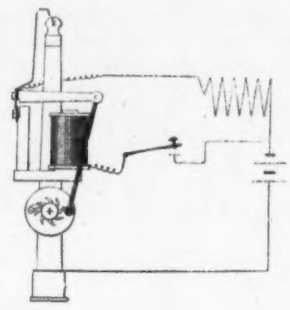
Many Electric Bells in One Circuit. Todd. *Amer. Elec.*, Sept.—An illustration, with description, of the well-known multiple bell circuit.

MISCELLANEOUS.

Lightning Rods.—Elek. Zeit., Aug. 5.—A reprint of a very long paper and discussion on this subject at a meeting of the Electrical Society in May; an abstract of a brief, general report was given in the *Digest*, July 3. The first part consists of a very long paper by Findeisen discussing the principles of lightning rods and describing a simple and cheap system devised by him; a shorter article describing his system was abstracted in the *Digest*, May 15; the article is accompanied by 42 illustrations. This paper is followed by a report by Strecker, of a committee which was appointed by that Society for reporting on this subject; the committee seems to have been appointed 12 years ago; their report in general seems vague and unsatisfactory, as it appears that little or no definite agreements could

be reached; half of the report is introductory and apologetic; it is questioned whether it is possible to state just how a good system of lightning rods should be constructed; the second portion gives some general hints, among which a few may be of interest. Some of the members thought a point on the end of the rod necessary and others the contrary; they all agree that the end need not be of platinum, nor gold plated; the upper part of the rod should be of gas pipe containing the copper wire; there was considerable disagreement regarding the metal of which the rod should be made; copper and iron seem to be equally well suited if their conductivity is the same; the cross-section is best round or in the form of a cable; it seems to be agreed that it would not be well to do without a special conductor, as the metallic roof covering, water pipes, etc., might be subject to changes which might be made, forgetting that they formed part of the lightning rod; a special lightning conductor is very necessary when not only ignition but mechanical destruction should be prevented, whereas a simpler system would be sufficient where only ignition is to be prevented, a slight mechanical disturbance not being of much consideration; the path of the conductor should be the shortest and straightest possible, bends and loops should be avoided. The question of the earth electrodes was a very difficult one to consider; the committee did not wish to decide on a maximum resistance for the earth connection, as this varies with the conditions; there was no difference of opinion concerning the importance of connecting all metallic pipes and other metallic parts of the building with the lightning conductor. In general, no agreement could be reached concerning the most important points; it was questioned whether it was possible to formulate definite rules concerning lightning conductors. This report and the paper was followed by a very long discussion, of which only a few of the remarks can be noticed here. Neesen claimed that the supposed action of a lightning rod to produce a silent discharge had no foundation in fact, and that it need, therefore, not be considered in the least in the construction of lightning rods; points on the ends of the rods are therefore unnecessary; large high rods are unnecessary; there are secondary actions which are due to the electricity which was distributed over the building and is suddenly set free; in lightning discharges the ohmic resistance is of no consideration whatsoever; in general he agrees with the statements in Findeisen's paper; the construction of a lightning rod should not be left to an ordinary builder or plumber, but its design and construction should be under the direction of an expert; he does not agree with the statement, often made, that a poor lightning rod is worse than none at all. Weber stated that there was no longer any doubt concerning the general utility of lightning rods, although there may be differences of opinion concerning the details; a poor lightning rod is better than none at all; an earth electrode which has given good results in practice may be formed of lime, especially in dry sand; the plate is laid in a large hole and covered with slacked lime, and then covered in such a way that rain water can collect at that place; he considers this better than an electrode made of coke. Benischke claimed that for high buildings or for buildings in mountainous regions the silent discharge plays an important part; this has been observed a number of times; the testing of lightning rods with a Wheatstone bridge should be abandoned; it is not necessary to bury the earth plates very deep, as the lightning will often distribute itself over the surface of the ground. West agreed with the latter point, especially as the surface of the ground is generally very wet when there is danger of lightning; lightning, however, sometimes precedes the rain. Aron believed that all the electricity will be discharged in the first bolt, but that the cloud soon collects more; he thinks the Franklin construction is not adapted for the quiet discharge; a bolt will follow a quiet discharge, and points are therefore useful in starting a path for the discharge; the secondary discharge in a building may become quite great; secondary reactions of the discharge are generally due to the sudden heating of the air by the current; secondary discharges are of special importance in powder magazines or where there are explosive materials; in those places they should be carefully avoided; the surface of the earth is a very good conductor and it is often a mistake to bury the plates in ground water. Dorn stated that one of the difficulties was to attempt to formulate rules covering all cases, as each case should be considered by itself; when a building contains water or gas pipes it should be obligatory to have them connected to the lightning-rod system; where there are gas or water pipes the electrodes should be in running or ground water and not have a greater resistance than 5 ohms; he recommends periodic revision of the lightning-rod system; the rules would also be different, depending on the degree of protection which is required. Nippoldt claimed that only general rules could be given, details being left to the constructor; connections with water and gas pipes should be compulsory; the rapidity of the discharge is equal to the product of the capacity of the electrode and the conductivity of the connection with the ground; the question of the capacity is often neglected; an earth connection with a large capacity in the upper strata of the earth is much cheaper and may often be much better; it is an error to suppose that the pure water in a creek is a better conductor than the upper layers of the earth; it is a mistake to insist upon placing the electrodes in ground water; a much better connection can often be made in the upper surface where the water and sewage from the house drains off; figures are given for what he considers the smallest allowable cross section; he does not indorse the statements often made regarding the zone of protection. In conclusion there is a long communication by Neesen describing a recent case in which an iron water pipe was cracked and burst open, presumably due to a lightning discharge, which passed down a tree and through a root to the pipe; the water pressure was small and the pipe had been in use for 22 years; there was no indication of fusion, although a piece was missing; he does not believe that the discharge always seeks ground water; a large surface plate is often sufficient; he questions whether the lightning discharge is oscillating in character, but thinks that the multiple discharges noticed are successive discharges of the same cloud; oscillating discharges take place only when the resistance is small in the rest of the circuit; when water resistances are connected in circuit with a Leyden jar discharge, it becomes continuous or consists of several successive discharges.

Automatic Gas Lighter.—L'Elec., Aug. 10.—A description of the Massy system; as will be seen from the adjoining cut, pressing the button causes the battery current to pass through the coil, which then move the armature, turning the stop cock through an angle of 45 degrees, which turns on the gas; on breaking the circuit the induction spark ignites the gas; a second depression of the button will turn off the gas.



Therapeutical Application of Undulatory Currents. APOSTOLI. *L'Eclairage Elec.*, Aug. 7.—An abstract of an Academy note in which he describes experiments made with currents which vary according to a sine law, but which are always in the same direction; he concludes that such currents are a very valuable acquisition in therapeutics, and he believes they will take an important place in the future.

Chronological History of Electricity. MOTTELAY. *L'Eclairage Elec.*, Aug. 7.—A long article, being supplementary to a long series published by him some years ago; in the present one he covers the period from 1800 to 1820, limiting himself chiefly to mentioning the principal authorities and their work.

Educational.—Lond. *Elec.*, Aug. 20—A reprint of two papers read before the International Congress on technical education, one, by S. P. Thompson, on "Reforms in the Organization of Technical Education" in which he recommends monotechnics as against polytechnics and shows the numerous futilities which pass for technical education; another, by Slingo, on "The True Basis of Technical Education."

Prizes.—L'Ind. Elec., Aug. 10.—A list of the prizes and conditions offered by the Muehouse Industrial Society for 1898; there are eight prizes for electrical subjects. A translation is published in the Lond. *Elec. Eng.*, Aug. 20.

Educational.—Elec. Eng., Aug. 26.—An article by D. C. JACKSON describing a course in alternating currents at the University of Wisconsin which is based on Jackson's work on this subject. This is followed by a reprint of a paper by OWENS on a course of study in electrical engineering calling attention to the difficulty of keeping abreast of the current development and pointing out useful expedients for a school which is distant from the large industrial centres.

Course of Reading on Electricity and Magnetism. PERRINE. *Elec. Eng'ing*, Aug. 14.—An outline of a course of reading, suggesting a number of books for a student "who wishes to lay a firm foundation for a working knowledge of engineering"; the books mentioned are of a general character and are chiefly for giving a good general foundation for beginning the study of the various branches in electrical engineering.

Test of an Electric Heater. STEVENS and LANPHEAR. *Amer. Elec.*, Sept.—Results of experiments in the laboratory of the University of Maine, of an electric heater in comparison with commercial alcohol and wood alcohol. The conclusion is that if electrical energy can be furnished for 15 cents per kw hour the use of the electric heater is about 30 per cent. cheaper than that of commercial alcohol, and about 18 per cent. cheaper than that of wood alcohol, for doing the same work for which a plate electric heater is suitable.

Electric Furnace Patent.—Eng. & Min. Jour., Aug. 21.—An abstract from the recent legal decision concerning the Acheson patent; the abstract refers chiefly to the description of the furnace and its operation.

Electric Furnace. PATTEN. *Elec. Eng.*, Aug. 26.—The conclusion of his serial describing furnaces; he describes several forms with rotating arcs.

Book Review.

The Theory of Electricity and Magnetism, by Arthur Gordon Webster, A. B. (*Harv.*), Ph. D. (*Berol.*). London, Macmillan & Co., Limited; New York, The Macmillan Company, 1897. 588 pages. Price, $3.50.

In his preface the author apologizes for the appearance of another treatise on electricity and magnetism, urging in behalf of the work an actual demand that he has found in his own experience as a teacher for a more didactic method. In our opinion he has made out his case sufficiently well to justify the publication, even when we take into consideration all the other treatises in existence, good, bad and indifferent.

The author's purpose is to educate the student in mathematics up to a certain point before introducing him to electricity. He says: "The physical difficulties connected with electricity are great enough without being mixed up with mathematical ones. It is also a pity to have the student get the idea that certain theorems pertain to electricity, when they really are simply matters of geometry and analysis." This is a good beginning certainly, for it is a very common error among moderately well-educated electricians to mix up purely numerical relations with physical ones.

Professor Webster believes that the "consideration of the Newtonian potential function is indispensable, not only to the old theory of action at a distance, but for the modern theory. * * *" In this opinion we concur, notwithstanding that no less a name than Maxwell's is recorded on the other side. Maxwell said that the whole theory of potential, considered as a quantity which satisfies a certain differential equation, belongs essentially to the method of Faraday. That is the concept of a medium for the transmission of all actions, as opposed to action at a distance. It is open to question, however, whether Laplace, Poisson, Green and Gauss would have agreed to this proposition had they been in the land of the living, so that their opinions could have been ascertained.

The author does not claim originality in the subject matter of the book, but in the manner of presentation. His endeavor is always to present a demonstration in the clearest and simplest way that is consistent with rigorous accuracy. In this he has probably succeeded to some extent, but after all, what is considered simple and perspicuous in mathematical demonstration is in a considerable degree a matter of education and of individual temperament.

Motors for Power Distribution in Factories.

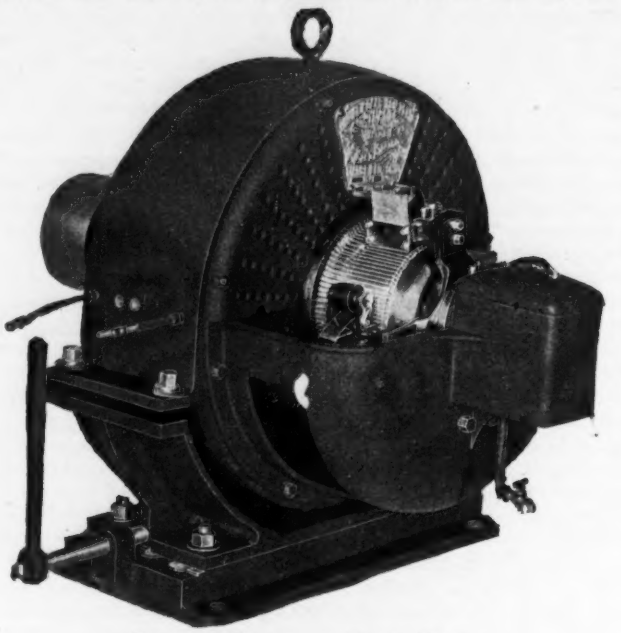
The distribution of power by motors in machine shops and factories to drive tools and machinery has become so general that a call has been created for special designs which will permit of their being put, without much additional cost, in out-of-the-way places so as to occupy little room,

Factory Motor on Wall Bracket.

and, if possible, no floor space at all. To meet this demand the Card Electric Company, of Mansfield, Ohio, has brought out the motor shown in the accompanying cuts (known as its S type), which can be set on the floor, or supported from a post or wall, or suspended from the ceiling.

Fig. 1 shows the motor with a bracket support for fastening to a post or wall. By changing the position of the armature bearings, *i. e.*, turning them one-half round on the pole frame, the bracket will be brought above the motor, which will then hang down. When the driving belt is to run horizontally from the motor or nearly so, this style of support is desirable, since the belt tightening screw is in the best position for quick adjustment.

The style of base shown in Fig. 2 is adapted to support the motor on the floor, as shown in the cut, or by changing the position of the armature bearings, in order to keep the oil boxes right side up, to support from the wall or ceiling. When the belt is to run nearly vertical this style of base



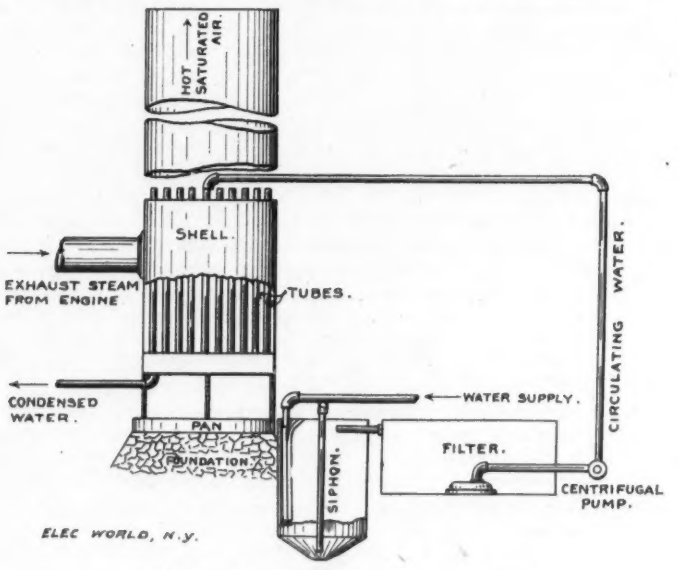
Factory Motor on Floor Base.

is better than the bracket for wall support, because of the better position of the belt-tightening screw. It is obvious that these motors can be used to drive shafting by gears as well as by belts when it is desirable to do so. As motors of this kind are frequently fastened to iron girders or posts in buildings and therefore grounded, protection to the armature and field coils is provided for in the construction, by heavy insulation between the pole frame and base. In all other ways care has been taken to insure rigidity and lasting qualities. These motors are made in sizes up to 15 horse-power.

Exhaust Steam Surface Condenser.

The condenser illustrated herewith utilizes saturating air as the coaling agent. It consists of a shell, containing as many 4-inch tubes as can conveniently be inserted, supported by legs which stand in a shallow pan. The shell is continued upwards, in either thin sheet iron or wood, to a suitable height, thus forming a flue.

A centrifugal or other pump circulates a volume of water, as shown, and,



Exhaust Steam Surface Condenser.

by a suitable arrangement on the upper tube plate, the water is caused, while descending the tubes, to form a film over the entire internal surface.

When exhaust steam enters the shell the tubes and water film become heated, the surface of the latter evaporating into the air in the tubes. As hot saturated air is considerably lighter than the atmosphere, an upward current ensues, the velocity of which depends on the natural draught due to the difference in weight between the hot saturated air and the atmosphere and the height of the flue, less the friction.

For every pound of water thus evaporated and carried off in the saturated air, one pound of steam condenses in the shell. The condensed water, as fast as formed, either flows off against atmospheric pressure, or is withdrawn by a suitable vacuum pump.

The temperature at which condensation occurs and the consequent vacuum obtainable depend on the volume of air passing up; the greater the volume of air the lower the temperature of saturation. The surface required can be distributed among numerous short tubes, where a high degree of vacuum is desired, or among fewer and proportionately longer tubes, as circumstances may dictate.

All the advantages derivable from the surface condensation of exhaust steam can thus be obtained for a slightly less water expense than when the engines are run non-condensing, and the current expense is merely that of running the circulating and vacuum pumps.

The settling tank and filter shown in the sketch are very useful accessories in the numerous localities where the only available water supply carries in solution mineral salts that would form scale in the condenser tubes.

This condenser is the invention of Mr. Arthur Pennell, Kansas City, Mo.

An Electrical Broiler.

The accompanying illustration shows a perspective view of a new electrical broiler, put on the market by the Globe Electric Heating Company, Philadelphia. The broiler shows a considerable advance over previous practice, as the following figures will show. The dimensions of the No. 1 size are 9 x 11 in. in plan, and the weight is 27 pounds. The power consumption is only 8 amperes at 110 volts. It is remarkably rapid, as it will broil steaks and chops in six minutes. The chief improvement in this

ELECTRIC BROILER.

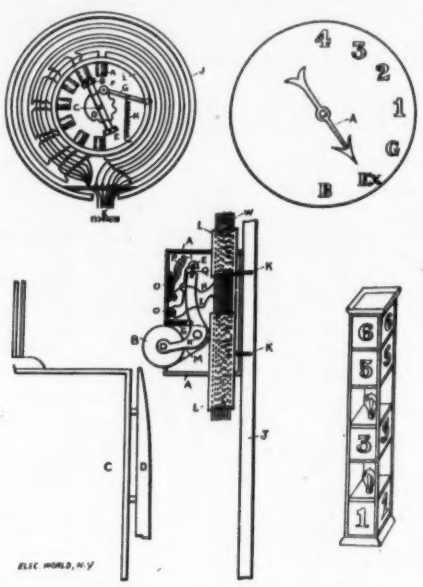
broiler is its heat retentiveness. As is well-known, all the power consumed in an electical broiling apparatus is simply wasted in external radiation. By reducing this radiation, the power consumption is correspondingly reduced. One trial of an electric broiler is sufficient to convince the most conservative of the advantages of the instrument over the present open-fire method. It is so much cleaner, neater, cooler and better in every way, that it readily commends itself to anyone. It is particularly adapted to cooking in open buffets or lunch rooms or in restaurant windows.

Electrical Travel Indicator for Elevators.

For the past year there has been in continuous operation at the Consolidated Exchange Building, New York City, a system of electric elevator indicators which has shown admirable results. There are two elevators in this building, one opposite Broadway and the other at the New Street entrance, which are therefore separated by a distance of 40 or 50 feet. Neither elevator is visible from the other. As it was therefore impossible to render satisfactory service by keeping the elevator cars operating in such directions as to economize in power consumption, indicating devices were absolutely necessary. Owing to the peculiar location of the two elevators mechanical devices were at a disadvantage, as it was desired to indicate on the lower main landing of each car not only its own but also the movement of the other car. The Griffen electric indicator was therefore adopted and has proven highly satisfactory.

The indicators consist of a series of small electromagnets, arranged in an arc with inwardly directed radial poles, fitted in a cylindrical metal casing; on the upper floor the indicators are double faced, a cover on each side having arranged around the outer circumference a series of figures corresponding to the different floors. A centrally pivoted spindle projects through each cover and has at each end a pointer which, through the movement of the shaft, moves from figure to figure. Inside of the casing the spindle is fitted with a counterbalanced radial arm having at its outer end an armature brought in close proximity to the magnet poles, which can readily be moved from one to the next and in either direction as each successive magnet is energized and the previous one de-energized. A brake is provided in the form of a notched wheel engaging with a spring-pressed roller latch. These double face indicators are placed edgewise, so as to be seen from either end of the hall. On the ground and basement floors double single-face instruments are provided at each elevator shaft for each elevator.

Near the guides in the shaft way, about 5 feet above each floor level, are placed iron switch boxes containing a normally open circuit contact device having a projecting arm which is operated by a cam bar at each end of the car. This is so arranged that when the car is at the landing the switch-arm is in its normal position. Each floor contact is connected with its corresponding magnets in all the indicators, the magnets all being in multiple. The wiring from the contacts to the indicator is in special moulding, and current is furnished by a Holtzer-Cabot motor dynamo. Each elevator car operates nine indicators simultaneously. Current is on the indicator magnets only for a short time and never when the car stops at a landing. The movement of the pointer in either direction occurs with equal exactness and simplicity. Although the installation at the Exchange has been in operation for over a year, no practical difficulties have been



DETAILS OF ELEVATOR TRAVEL INDICATOR.

experienced regarding the permanence of the contact devices and positive action of the indicator.

In another form of the Griffen indicator a series of incandescent lamps placed behind a transparent figured glass is used instead of the magnet and pointer mechanism. The general plan of this electric-light indicator is similar to the pointer device, each lamp being controlled by the contact switch at the particular floor indicated by the lamp. These devices are being manufactured by Zimdars & Hunt, New York City, who have developed and perfected the electric-light indicator, believing it to possess advantages over any other type.

This new indicator and the improved switch used therewith is here illustrated. The indicator proper consist of an oblong casing having on its face and two sides the transparent glass discs, each inscribed with a floor number. Behind each is a small incandescent lamp held in a socket attached to the back board, and which is readily reached by removing the outer casing. A wire from each lamp extends to the floor-contact switch. The latter is shown at the side of the indicator. This switch serves the same purpose as the above described floor contact. All the switch parts are mounted on but thoroughly insulated from the iron base. An actuating bar having a roller at its end projects into the shaft. This bar has a reciprocating movement in a suitable slide, and is arranged to coact with the double-pole knife switch so that when it is pushed inward the switch is closed, and when released and returned to its normal position the switch is released, opening the circuit with a quick break movement which is independent of the actuating rod. The switch parts are all constructed of copper. The movement of the actuating rod is resisted by a heavy spiral spring. Solidity of construction and the simplicity of the complete apparatus are particularly notable.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, August 30, 1897.

ELECTRICAL STOCKS.—Inaction seems to have been the prevailing characteristic of the electrical stock market this week. Transactions have been few and changes in quotations not very large, the majority of them showing trifling declines. Edison Electric Illuminating of New York advanced 1 point over last week's closing figures. General Electric, with small transactions, closed at the same figures as on the preceding week.

TELEGRAPH AND TELEPHONE.—There seems to be nothing remarkable or particularly noteworthy in this list of stock this week. American Telegraph & Cable depreciated 1½ points on small sales.

ELECTRIC TRACTIONS.—These stocks have been absolutely inactive this week, and the market has been absolutely without feature. Columbus Street Railway declined 2 points and Buffalo Street Railway fell off 1 point. North Shore Traction common stock made an advance of 1 point, as did also Worcester Traction. The sales during the week of these stocks were not large, Brooklyn Rapid Transit heading the list with 10,096 shares.

	Par.	Bid.	Asked
ELECTRICAL STOCKS.			
Chicago Edison Company	100	121	..
Edison Electric Ill., New York	100	124	125
Edison Electric Ill, Brooklyn	100	115	117
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill, Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	27¼	27¾
Electric Storage, pref	100	30½	31½
General Electric	100	36⅜	36½
General Electric, pref.	100	80	82
Westinghouse Consolidated, com	50	21	23
Westinghouse Consolidated, pref.	50	55	5[illegible]
BONDS.			
Edison Electric Ill, New York, con. 5s	105	112⅞	..
Edison Electric Light of Europe	100	75	85
General Electric Co, deb 5s	100	100	..
TELEGRAPH AND TELEPHONE			
American Bell Telephone	100	236	238
American District Telegraph	100	..	27
American Telegraph and Cable	100	91	94
Central and South American Telegraph	100	124	127
Commercial Cables	100	170	..
Erie Telephone	100	66¼	66½
New England Telephone	100	104½	105½
Postal Telegraph Cable	100	99	101
Western Union Telegraph	100	91⅞	92
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18⅛	18⅜
Brooklyn Rapid Transit	..	33	34
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	75	77
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	38	42
Hestonville	100	49⅞	50
Hestonville, pref.	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref.	100	25	35
North Shore Traction	100	21	25
North Shore Traction, pref.	100	82	84
Rochester Street Railway	..	13	15
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	100	110
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	93¼	93¾
West End, Boston, pref.	100	100	100½
Worcester Traction	100	17	19
Worcester Traction, pref.	100	90	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	88	..
*Buffalo Street Railway 1st con. 5s	100	109	111
Cleveland Electric Railway 1st mtge. 5s	100	102	104
*Columbus Street Railway 1st 5s	100	95	97
Rochester Street Railway 1st 5s	100	90	..
Union Railway (Huckleberry) 1st mtge. 5s	..	106	108
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, September 1, 1897.

MR. GEORGE A. McKINLOCK, of the Central Electric Co., Chicago, is on a visit to New York. Mr. McKinlock looks the picture of health, and says the business feeling in the West is very much improved.

THE ARMORITE INTERIOR CONDUIT COMPANY, of Pittsburg, Pa., is now represented in the metropolitan district by Messrs. R. D. Corey and Oscar Hoppe, 711 Havemeyer Building, New York City.

MR. R. W. BLACKWELL, of London, formerly identified with the old Bentley-Knight Electric Company, has returned to this country to examine in behalf of English clients what novelties America has to show in the way of electric traction.

FEDERAL BUILDING'S NEW LIGHTING PLANT.—The new electric lighting and heating plant in the Federal Building has been inspected and approved by Chief Inspector Powell, of the Treasury Department, at Washington. It is claimed that by the new system a saving of at least $35,000 will be made over the old method.

HEATING A LARGE BUILDING.—Warren Webster & Co., through their New York office, 322 Broadway, have secured a contract for changing the present steam heating system in the New York Life Insurance Building to the Webster system. The above-named building contains over 5,000,000 cubic feet of space, and is one of the largest in the City of New York.

MR. A. A. THRESHER, president of the Thresher Electric Company, Dayton, Ohio, is in New York, superintending the installation of an extensive power distribution plant in one of the large manufacturing buildings, in which the Thresher machines will be used. The motor equipment will include about thirty machines, located throughout the building and ranging from 3 to 75 hp. in size.

PACIFIC POSTAL CABLE MEETING.—At the annual meeting of the stockholders of the Pacific Postal Telegraph Cable Company, which was held in the offices of the company, 253 Broadway, yesterday afternoon, the following directors were re-elected for the current year: John W. Mackay, William Van Horne, Charles R. Hosmer, Lord Mount Stephen, A. B. Chandler, William H. Baker, George G. Ward, E. C. Platt and R. V. Dey. A meeting of the above directors will, it was said, be held Tuesday next, at which officers for the ensuing year will be elected.

WORK ON THE BROOKLYN BRIDGE EXTENSION.—By the time this paper has reached its readers, work will probably be in active progress on the construction of the trolley roads over the present Brooklyn Bridge. The work has been delayed by the failure of the trolley companies to file their bonds of $100,000 each, but the contract called for the filing of these bonds on or before September 2. The contractors will no doubt hurry matters as soon as these bonds are filed, as there is a premium of $500 per day provided for completing the work before the specified time.

ELECTRICITY FOR SUBURBAN RAILROAD TRAFFIC.—The Atlantic Avenue Improvement Commission of Brooklyn has taken the matter of the Long Island Railroad Company's surface tracks in that avenue in hand. They have notified the Long Island Railroad Company that the latter must either depress its tracks or give up the use of steam. If the tracks are depressed, as the Improvement Commission contemplates, in a tunnel, it appears as though the Long Island Railroad Company would be obliged to give up the use of steam anyway. The adoption of electricity on this section of the Long Island road would undoubtedly be followed by its extension to the rest of its very large suburban system.

RAPID TRANSIT IN NEW YORK CITY.—The Park Commissioners on Monday denied the application of the Rapid Transit Board for permission to tunnel Battery Park for a loop of the underground road. The Commissioners held that the plans approved by the Mayor and Aldermen would damage the trees in the park, by cutting their roots, and that the Rapid Transit Commissioners had no authority to agree to a modification of them. This will require a readjustment of the plans for the Battery terminal or an abandonment of the line below Bowling Green, if not entirely below the Post Office loop, on account of the difficulty of making a loop in any of the narrow, sharp-cornered streets in that part of the city.

UNNECESSARY TRACKAGE OF RIVAL STREET RAILWAY COMPANIES.—The tracks of the Metropolitan Street Railway Company, in Amsterdam Avenue, which are now being equipped with the underground conduit, as described in THE ELECTRICAL WORLD of August 28, are paralleled by a pair of tracks immediately alongside, belonging to the Third Avenue Railway Company. The latter company has also applied for a change of motive power from horse to electricity or compressed air, at its own option. It occurred

to Commissioner Collis, of the Department of Public Works of New York City, that the two roads had far better use the same tracks and leave the rest of the street for other vehicles than to have four tracks as at present. The avenue runs through a residence district, and the service is not sufficiently frequent to nearly tax the capacity even of two tracks. It was thought that the city might have the power to compel the railroads to adopt this course, but Corporation Counsel Connolly rendered an opinion on August 30, that the city had no such authority, much to the disappointment of Commissioner Collis.

ACCIDENTS NEVER COME SINGLY.—The Edison electric light and power plant at Paterson, N. J., suffered unfortunately Sunday evening, August 29, from an after-effect of its more serious accident of two weeks ago, as described in THE ELECTRICAL WORLD of August 21. The two large feed pumps in the boiler room were intended to serve one for use and the other for reserve. One of them was utterly disabled by the heavy fall of coal upon it in the accident and was undergoing repairs. At about 9 P. M. last Sunday the other pump stuck tight, its piston rod having apparently been bent slightly in the accident, but not enough to immediately disable it. The station was at the time carrying a heavy load of incandescent lights, arc lights and a great many street cars. The street-car system and arc-light system were necessarily immediately shut down; the incandescent lamps were kept running at low voltage by the water stored in the boilers until the pump difficulty was remedied, when the whole load was again picked up. The interruption lasted little less than an hour.

THE BROOKLYN UNION EDISON ILLUMINATING STATION.—Work is being driven on the new station of the Edison Illuminating Company, the foundations for the water-tube boilers, from Aultman & Taylor Machine Company, Mansfield, Ohio, now being erected. Some of the overhead coal pockets are in place, and work is also being pushed on the underground arches, which are a feature of this plant. There are two of the arches, built as close to each other as possible, and extending the entire length of the power house, out under the ocean, or rather the bay. These arches are for supplying the condensing water to the engines. One of the arches is for bringing the water from the bay, the other for carrying off the water after it has been used. The arches are apparently about 12 feet high from base to spring, and about 8 feet wide, each. A heavy coffer dam has been built around the place where the outer end of the arched conduits will terminate, and electric pumps are being temporarily installed to handle the water inside of the coffer dam. At present two of the pumps are in place, and are direct connected to motors placed on the same base with the pump, each pump being separate, and driven by its own motor. Current is taken from the high tension lines of the company, and carried to three step-down transformers, where it is developed into a low-pressure alternating current of about 83 volts. From the converters, the current is carried to a pair of General Electric rotary transformers, type T. C., Firm A, Class 4, 100,750, Speed 750, giving a continuous current of 800 amperes under 125 volts to each machine. The alternating current, as delivered to them, is to be of 80 volts, 25 cycles. It was found necessary to set up a small motor and a rotary air blower to force air to the step-down transformers, which was done by building a rough wooden box around the lower part of the transformers, and conducting the air directly thereto from the fan. This temporary plant will drive the centrifugal pumps for keeping the coffer dam dry, and it will also furnish current for driving the overhead traveler, which is to be placed in position over the engines. Other pumps are at hand upon the ground, ready to be put to work in the coffer dam should the two already in place fail to do the necessary work. The transformer plant is all placed directly on the ground, only a few planks being placed underneath the rotary transformers, no other foundation having been put in. The outfit above described is easily handled by one man, and displaces several steam engines and boilers, requiring tow men each. It is an object lesson to contractors who insist upon putting from two to a dozen puffing engines and smoking boilers in a building while under construction, when all the work could better be done with power from one engine and boiler or from the city electric mains, and a small, easily handled motor placed at each hoist or derrick. As stated, it is a good object lesson, and contractors should study it for all it is worth.

ST. LOUIS NOTES.

ST. LOUIS, Mo., August 30, 1897.

RIVAL TELEPHONE COMPANIES.—The Kinloch Telephone Company last week commenced to erect its poles, preparatory to operating a system of its own in East St. Louis. The company received a franchise from the East St. Louis Council at its last meeting to lay poles for its proposed system in that district. The local manager claims to have 300 subscribers to the system, at a rate of about one-half that of the Bell Telephone Company. It is expected a war in rates will be inaugurated. The Kinloch people have made contracts providing that they will have their system in running order by July, 1898, but the management now claims that it will have the poles up, wires strung, and in working order before March 1 next.

PITTSBURG NOTES.

PITTSBURG, Pa., August 30, 1897.

ULTIMATUM FROM THE CONSOLIDATED TRACTION COMPANY.—The latest move in the right of way dispute between the Consolidated Traction Company and the Borough Council of Wilkinsburg, is a long communication issued last week by the Traction Company, and addressed to the committee of Council. This letter states very clearly and explicitly exactly what the company proposes to do in return for the privileges asked for, and describes the routes that it proposes to follow, and the method of running the cars. A 5-cent fare to the city is promised, and also an all-night car service, short intervals between cars, and a choice of routes into the city. The plans of the company contemplate the complete reconstruction of its tracks in Wilkinsburg, and for this reason it states that an agreement must be reached not later than the 10th of September. Otherwise matters must remain as they are until next summer, including the 7-cent fare and transfer at the city line. The Traction Company's ultimatum will probably be acted upon this week by the Borough Council.

MORE TROUBLE FOR THE BELL TELEPHONE.—The Central District & Printing Telegraph Company is having troubles of its own with the Wilkinsburg Council, which body seems to be a thorn in the flesh of the big corporations. As previously related in THE ELECTRICAL WORLD, the C. D. & P. Company has recently erected in the borough a great many poles which, in the opinion of Council, are superfluous, and their erection unauthorized. The Burgess was instructed to have them removed, but was prevented from doing so by a temporary injunction secured by the C. D. & P. Company. Last week a gang of men started to string wires upon the objectionable poles, but the work was soon stopped by the Burgess. Arguments as to whether the injunction shall be made permanent or dissolved will be heard by the court this week. The Council hopes to have the injunction dissolved and the poles removed. The opinion seems to prevail that the chief object in the erection of the poles is to occupy the streets, with the view of shutting out the threatened competition of the Home Telephone Company.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., August 30, 1897.

ON AUGUST 24, the firm of Elmer G. Willyoung & Co., of Philadelphia, suffered a severe loss by fire. The building on Nassau Street occupied by them as an experimental shop and for the manufacture of induction coils and X-ray apparatus, was destroyed. The loss to Messrs. Willyoung & Co. was about $3000, the insurance being $2500. New quarters were necessarily secured at once and work was resumed. Orders will not be delayed more than three or four days.

SOUTHERN NOTES.

RICHMOND, Va., August 30, 1 97.

CHARTER GRANTED.—At an adjourned meeting of the Charlottesville City Council on August 19, a charter was granted to the Albemarle & Charlottesville Telegraph Company.

A REMARKABLE ADVERTISEMENT.—A curious thing is reported from Staunton, Va. The telephone people, whose experience with pretty telephone girls has not been altogether satisfactory, advertised for ugly girls and there were twenty-five applicants!

A DEED OF TRUST FILED.—The Portsmouth, Va., Light & Water Company has filed a deed of trust to the Farmers' Loan & Trust Company, trustee, to secure consolidated first mortgage bonds. Total issued, $500,000; dated July 1, 1897.

ELECTRIC HEADLIGHTS.—The Seaboard Air Line, whose officers are always on the lookout for the safety of their passengers, will in a short time put electric headlights on all their locomotives. A trial light was put on and was a decided success.

DECIDED AGAINST THE BELL COMPANY.—At a late meeting of the Town Council at Hampton, Va., the question whether or not the Bell Telephone Company would be admitted to Hampton was argued, and finally decided in the negative. The vote of the Councilmen was a tie, and Mayor J. Barrow Thorpe gave the deciding vote against the Bell Company, and the question was finally settled.

THE TELEPHONE WAR IN RICHMOND.—The recent decision of Judge Goff concerning the rights of the Bell Telephone Company at Richmond to maintain its exchange, notwithstanding the withdrawal of its franchise by the city government, has created much comment and has led the Young Men's Business Association to take action. They have called upon the citizens to support the Richmond Telephone Company, an independent locally organized concern, which is giving excellent service, and to have the Bell instruments taken out of their premises. It is likely that this will be done in many cases, as the action of the Bell Company in suing the city, and in attempting to renew its franchise through the agency of the American Telephone & Telegraph Company, commonly known as the Long Distance Company, has greatly incensed the citizens.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., August 28, 1897.

A LARGE BOND ISSUE.—The Livermore (Cal.) Water & Power Company recently filed a certificate setting forth that it had issued bonds to the amount of $100,000.

PROFESSOR C. L. CORY, of the electrical department of the Mechanical School, University of California, has returned to Berkeley, after an extended vacation trip to Indiana and elsewhere.

THE BROOKS-FOLLIS COMPANY, of San Francisco, doing an electric supply and contracting business, was recently incorporated by J. H. Follis, H. Brooks, J. W. Brooks, R. N. Follis and E. A. McInerney.

A NEW RAILWAY.—The Los Angeles (Cal.) Traction Company recently began work on its Eighth Street extension, which will connect Figueroa Street with a new residence district, passing by Westlake Park.

AN ELECTRIC RAILWAY PROJECT.—Since the announcement of the rich strike in the Trinity mining district the project of an electric railroad to Weaverville, Cal., has been revived with good prospects for its success.

RENEWAL OF STREET LIGHTING CONTRACTS.—The city of Stockton, Cal., has renewed the street-lighting contract held by the Stockton Gas Light & Power Company, at the rate of $11.25 per month per arc light. The rate for the past year was $11.70 per light on a moonlight schedule, which is still in force.

A NEW CENTRAL STATION.—The large Siemens & Halske electric lighting and power plant in the Parrott Building, San Francisco, has passed into the hands of a syndicate, controlled by A. E. Brooke Ridley, who will operate it for central station lighting under the name of the Central Light & Power Company. The underground mains will be extended, and other extensions made.

NEW INCORPORATIONS.—Among the recent incorporations is that of the Electric Power & Mining Company, of Portland, Ore., which was incorporated by H. W. Goode, W. W. Burkholder and J. C. Baird. Its objects are: Generating and furnishing electric power, and to acquire water rights, particularly at Savage Rapids, near Grant's Pass, Ore.; also to supply water for various purposes, including mining. The capitalization is $25,000.

MR. D. R. DAVIS, superintendent of construction for the Western Union Telegraph Company, has returned from Chicago, where he made arrangements for stringing an additional copper wire between that city and San Francisco. Work will be commenced at both ends, and will be completed within sixty days, if possible. The extra demand for news of gold strikes and grain crops has overtaxed the present capacity of the system.

A POWER CONTRACT.—The city of Tacoma, Wash., has accepted the bid of J. O. Carr, representing the Tacoma Railways Company, for supplying power to drive the geenrators of the city's electric lighting plant, at a rate amounting to about $1.62 per kilowatt hour. It is said that the present expenditure for wood at the city station is 1.4 cents per kilowatt hour. It will be a long-term contract, and the dynamos and several boilers will be moved to Railways Company's station. Thirteen hundred horse-power will be supplied.

THE CENTRAL LIGHT & POWER COMPANY has been incorporated in San Francisco, Cal., by Frank Pauson, Joseph Naphtaly, C. L. Ackerman, A. E. Brooke, Ridley, J. M. Leowe, Garrison Gerst and J. W. Pauson. Capital stock, $1,000,000, of which $50,000 is subscribed. Important improvements will be made in connection with the Parrott Building electric power plant, which the company has acquired, and the underground service will be extended down Kearny and other streets where contracts have been secured.

ELECTRICAL EXHIBITS AT THE SAN FRANCISCO MECHANICS' FAIR.—The annual fair of the Mechanics' Institute of San Francisco opened under favorable conditions, August 17. The electrical and other exhibits are much superior to those of last year. Among the electrical exhibits of merit are those of the Washburn & Moen Company, which has branch works in this city; the San Francisco Gas & Electric Company, the Western Electric Company, of San Francisco; Van der Naillen's Engineering School, Herald's Business College and the Union Iron Works. Chas. C. Moore & Co. display a handsome exhibit, including Green's fuel economizers, Babcock & Wilcox boilers, electric pumps, etc. The fair will remain open one month.

STORAGE BATTERY STATION IN SAN FRANCISCO.—The San Francisco Gas & Electric Company has let contracts for the construction of a two-story brick building adjoining its low-tension station on Stevenson Street, between Third and Fourth Streets. In the new structure, which will be 80 by 70 feet, are to be installed, by November 1, the chloride cells, which will be used as auxiliaries to the underground system. The capacity will be 7000 incandescent lamps for three hours. The company is laying new conduits on Stevenson, Third, Market, Sutter and Montgomery Streets, extending to Washington Street. The ducts contain "G. E. Co. 1000" feeders. The present output of the company's electric stations is about 2600 arc lights, 93,000 incandescent at 16 candle-power, and motor service amounting to 1000 horse-power. The coal consumption is approximately 30,000 tons per year. The company's property is assessed at $1,900,000.

MEETING OF THE PACIFIC COAST TRANSMISSION ASSOCIATION.—The second meeting of the Pacific Coast Electric Transmission Association was held August 15 and 16, in Santa Cruz, Cal. The subject discussed was "Insulators for High Potentials on Power Circuits." Papers were read by Henry D. eSars, Dr. C. Van Norden and T. A. W. Schock. Mr. Eastwood, of the San Joaquin Electric Company, read a paper on "Line Construction." The members visited the electric station of the Big Creek Power Company. The companies which sent representatives were: The Sacramento Electric Power & Light Company, the Blue Lakes Water Company, the Big Creek Power Company, the San Gabriel Electric & Power Company, the Central California Electric Power Company and the San Joaquin Electric Company. The Nevada County Electric Power Company and the Southern California Power Company are members of the Association. The next session will be held in Sacramento, Cal., October 20 next.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, August 18, 1897.

ELECTRIC LIGHTING IN PASSENGER STEAMERS.—The Board of Trade has recently issued instructions to marine surveyors to see that the dynamo-electric machinery on English passenger steamers is placed sufficiently high up in the vessel to prevent it being interfered with in the event of the partial flooding of the compartment in which it is situated.

THE ENGINEERS' STRIKE.—I am afraid that the plans made by a large number of our central station engineers, in view of the coming winter, will be completely upset by the great engineering strike, which is at present going through the usual course of strikes. Reports come to hand from every direction that new plants ordered are not likely to be delivered in time to supply light during the dark days.

ELECTRIC TRACTION IN LIVERPOOL.—With reference to the decision of the Liverpool City Council to adopt electric traction, the Tramways Committee recently recommended the Council to appoint Mr. Pearson, an American engineer, to superintend the carrying out of experiments in that city with the trolley system. This suggestion was negatived by 9 votes to 5, and as a consequence the chairman of the committee, Sir Arthur B. Forwood, M. P., has resigned, and there would seem to be every probability of a politico-municipal struggle.

DAMAGE BY LIGHTNING.—An occurrence exceedingly rare, if not unique, in this country, recently occurred at Aberdeen. During a tremendous thunder storm a flagstaff on the top of one of the hotels was struck by lightning. The discharge, after descending the flagstaff ran along the leads and spouts of the building into the interior piping, thence it got access to the wiring, and from thence it got into the mains, blowing the house fuses. Having once got into the mains it had no difficulty in getting access to a faulty armature and sparking through it to earth, with the result that the armature was irretrievably damaged. As it happens the pecuniary loss is not very great, since the armature, the wiring of which has thus been ripped off by an "act of God," was about to be sent away to be rewound, so that, although the value of the armature copper has been lost to the owners of the dynamo, they have been saved the expense of the labor of unwinding it.

THE NATIONAL PHYSICAL LABORATORY.—Some little time ago a deputation representative of the science of the United Kingdom waited upon Lord Salisbury to suggest the desirability of establishing a national physical laboratory. This deputation met with somewhat scant courtesy, and it was therefore a little surprising last week to have it announced that the Treasury had appointed a small committee to consider and report upon the desirability of establishing a national physical laboratory. And the surprise was not lessened when the excellent constitution of the committee was observed. The following are the members of this body: Lord Rayleigh (chairman), Sir Courtenay Boyle (permanent secretary to the Board of Trade), Sir Andrew Noble, Sir John Wolfe Barry (president of the Institution of Civil Engineers), Mr. W. C. Roberts-Austen (chemist to the Royal Mint), Sir Robert Chalmers (of the Treasury), Prof. A. W. Rucker (Royal College of Science), Mr. Alexander Siemens and Prof. T. E. Thorpe (Royal College of Science). The constitution of this committee should satisfy the most ardent advocates of the national physical laboratory. Of course, the appointment of a committee does not mean the establishment of a laboratory, but it is a very decided step forward in that direction.

ELECTRICAL CABS FOR LONDON.—To-morrow the press has been invited by the London Electrical Cab Company, Ltd., to witness the inauguration of a service of electric cabs, the inaugurator being Mr. W. H. Preece, C. B., F. R. S. As your readers may perhaps recollect, the London Electrical Cab Company was formed nine months ago, with a great flourish of trumpets, to construct electrically propelled vehicles to ply for hire in the streets of London. Among the most valuable purchases which the public were asked to make at the time of the subscription, were Mr. Walter C. Bersey's patents for motor control. As soon, however, as practical experiments were commenced, it was seen that a modification of the American controller system would have to be used if success was to be attained. One of their most valuable purchases, therefore, has turned out valueless, but I have not heard that any money was returned to subscribers in consequence of this little mistake. The company now states that experiments with vehicles having solid rubber tires disclose the fact that the tractive effort on good London wood-paved roads barely exceeds that of a tramcar running on rails, and even on ordinary macadamized roads the energy is not much greater. It, however, disclaims any intention of endeavoring to use these cabs on ordinary muddy country roads. On each cab there are to be 40 E. P. S. traction-type cells, having a capacity of 170 ampere-hours when discharged at a rate of 30 amperes. The electrical and mechanical equipment will consist of a 3-hp Johnson-Lundell motor, with double-wound armature and double-wound field. Thus equipped, it is expected that the cabs will be able to cover an average distance of 50 miles before the cells will require recharging. The cells are mounted, as is usual, in a tray, spring slung from the car frame. The motor drives onto a countershaft and thence onto the axle. The chains connecting the countershaft with the driving wheels are of Hans-Reynolds latest laminated type, dispensing entirely with the usual sprocket arrangement and running on the pinion and chain wheel with the same side play as a belt, thus wearing the chain evenly and enabling it to be used with the same efficiency as when new until completely worn out. The controller is arranged so as on the first step to connect the armature windings and the field windings in series with a small starting resistance. On the second step the windings are still in series, but the resistance is cut out and with this arrangement the cab will run at a speed of about 3 miles an hour. The third step places the armature in parallel, but leaves the fields in series, and with this arrangement the cab runs at about 7 miles an hour. The fourth step places the field windings in parallel and the cab runs at 9 miles an hour. In the reverse direction from the stop position, the short controller short circuits the motor through the starting resistances, thus applying a gentle braking action. On the second step backwards the motor is completely short circuited, bringing the cab to a dead stop, and the third step backwards reverses the connection between the armature and fields (all being in series), and enables the cab to be moved backwards at a slow pace. The whole of these movements are produced by the action of one lever placed at the side of the driver's box. The circuit from the accumulators to the controller and motor passes through a switch attached to a foot brake. This switch is arranged to break the circuit when the foot brake is applied. It is therefore impossible for either the electric or the foot brake to be applied while the current is passing. The foot brake has the advantage that in a crowded London street when moving in a traffic block, the driver can set his controller handle to "slow ahead" and then start and stop the cab time after time as the traffic slowly moves forward by simply putting on and taking off the foot brake. The charging arrangements of the London Electric Cab Company have been well thought out. It is proposed to obtain current for charging the accumulators in various parts of London from the various local electric supply companies. The first charging station is at Juxon Street, Lambeth, on the south side of the river, where current is purchased from the London Electric Supply Corporation (Deptford) at a pressure of 2400 volts alternating. This is converted into continuous current by means of motor generators. The Shoreditch Vestry in the north of London has also entered into a contract with the company for the supply of current, when required, the probable price being 1½d. per unit. Since the formation of the company in November last considerable thought and ingenuity seem to have been bestowed upon the electrical, mechanical and commercial details, so that it may be reasonably hoped that financial success will attend this enterprise.

General News.

NEW INCORPORATIONS.

THE HOBART ELECTRICAL COMPANY, Troy, N. Y., has been formed with a capital stock of $30,000.

THE EAU CLAIRE TELEPHONE COMPANY, Eau Claire, Wis., has been incorporated with a capital stock of $100,000.

THE WISCONSIN VALLEY TELEPHONE COMPANY, Eau Claire, Wis., has been incorporated with a capital stock of $200,000.

THE LAWRENCE TELEPHONE COMPANY, Ironton, Ohio, has been organized by W. B. Seaton, F. E. Hayward and Julius S. Anderson.

THE PEOPLE'S LIGHT, POWER & STREET RAILWAY COMPANY, Paducah, Ky., has been incorporated with a capital stock of $50,000.

THE ONEIDA TELEPHONE & TELEGRAPH COMPANY, Oneida, N. Y., has filed articles of incorporation. The directors are J. T. Durham, J. D. Denn, Dr. M. Cavano and others.

THE INTERSTATE TELEPHONE & ELECTRIC COMPANY, Dubuque, Ia., has been organized by F. F. Sapp, of Chicago, and E. T. Keim, of Dubuque, with a capital stock of $100,000.

THE WESTFIELD TELEPHONE COMPANY, Westfield, N. Y., has been formed with a capital stock of $5500. The directors are Robert J. Morehead, Clayton J. Bannister, and others.

THE OZONE PARK TELEPHONE COMPANY, Ozone Park, L. I., has been incorporated, with a capital stock of $5000. The directors are James A. Pietsch, William A. Jephson and others.

THE MONTANA POWER COMPANY, Butte, Mont., has been incorporated with a capital stock of $600,000. The incorporators are Henry M. Byllesby, W. W. Turner and Max Hebgen.

THE PACIFIC TELEPHONE & ELECTRIC COMPANY, Los Angeles, Cal., has been formed with a capital stock of $200,000. The directors are T. M. Gibson, H. J. Lloyd, P. L. Griffin, S. H. Griffin and others.

THE CENTRAL LIGHT & POWER COMPANY, Sacramento, Cal., has been incorporated, with its principal office in San Francisco. Capital stock, $1,000,000. The directors are Frank Pauson, C. L. Ackerman, and others.

THE PEOPLE'S TELEPHONE COMPANY, Mount Hope, Wis., has filed articles of incorporation with the Secretary of State, at Madison. The incorporators are Andrew Cairns, E. D. Orr and William Leighton. Capital stock, $1,072.

THE EAST SIDE ELECTRIC RAILWAY COMPANY, Kansas City, Mo., has filed articles of incorporation at Jefferson City. The stockholders are Joseph Heim, Ferd Heim, Michael Heim and C. S. Palmer, and the capital stock is $2000.

THE CLEVELAND ELECTRICAL & TELEPHONE SUPPLY COMPANY, Cleveland, Ohio, has been incorporated with a capital stock of $10,000. The incorporators are J. F. Clark, John L. Calvin, Manley Tello, Herbert L. Lilly and Morton W. Cope.

THE OLDS MOTOR VEHICLE COMPANY, Lansing, Mich., has been incorporated with a capital stock of 50,000. The officers of the company are E. W. Sparrow, president; E. F. Colley, vice-president; A. C. Stebbins, secretary, and R. E. Olds, treasurer. The purpose of the company is to manufacture horseless carriages.

THE SUSSEX TELEPHONE COMPANY, Morristown, N. J., has been incorporated with a capital stock of $3000, to operate a telephone line in Sussex and Warren Counties. The incorporators are E. E. Hall, Brooklyn, James B. Van Etten and John P. Van Etten, of Conashaugh, Pa.; Edgar J. Wright, of Newton, N. J., and others.

THE LOS ANGELES & PASADENA RAILWAY COMPANY has filed articles of incorporation at Phoenix, Ariz. Among the incorporators are Andrew McNally, D. B. Dewey, J. W. Hugus and Gen. M. H. Sherman. The new company proposes to build a road from Los Angeles to Pasadena, a distance of 25 miles, at an estimated cost of $1,000,000.

THE BALTIMORE, NORTH POINT & BEAR CREEK ELECTRIC RAILWAY COMPANY, Baltimore, Md., has been organized by Samuel Greenwald, Sr., John T. Smith, Henry G. Bready and others. Capital stock, $300,000. The officers are president, Daniel Teller; secretary and treasurer, Robert H. Carr, Jr.; general manager, Samuel Greenwald, Sr.

THE LIBERTY LIGHT & POWER COMPANY, Liberty, N. Y., has been formed for the purpose of manufacturnig and selling electricity to the villages of Liberty and Monticello. The directors are Van Wyck Rossiter, of Brooklyn; Frank McGovern, of New York; Isaac M. Sutton, of Flushing; Hobart Porter, Jr., of Lawrence, and J. H. Sharpe, of Liberty. Capital stock, $25,000.

THE NATIONAL TELEGRAPH & TELEPHONE COMPANY, Fort Wayne, Ind., has been incorporated under the laws of West Virginia, with a capital stock of $1,000,000. The directors of the new company are as follows: Charles H. Corey, D. J. Cable, W. H. Duffield, William M. Parmenter, Frank W. Holmes, Samuel W. Foster, Charles S. Bash, Henry C. Paul and George W. Beers.

THE TELEGRAPH AND TELEPHONE.

DES MOINES, IA.—The Council has given the American Telephone Company the right to enter the city.

NORTHVILLE, MICH.—The Northville Telephone Company's line between Novi and Northville has been completed.

SHELBINA, ILL.—The Shelby County Telephone Company is building a telephone line from this place to Clarence by way of Lentner.

NEWPORT NEWS, VA.—The Town Council has granted permission to the Hampton Telephone Company to operate its system in this city.

SPOKANE, WASH.—The Rocky Mountain Bell Telephone Company is stringing the wire for the new line between Spokane and Coeur d'Alene.

KANKAKEE, ILL.—The Chicago & Eastern Illinois Telephone Company will build a line for direct communication between Kankakee and Danville.

OSWEGO, N. Y.—The Ontario Telephone Company has been granted a franchise to operate in this city, and it is stated that work will be commenced on the new telephone exchange immediately.

LARAMIE, WYO.—A telephone line will be constructed from Walden, North Park, to this city. The company will be known as the North Park Telephone Company, with headquarters at Walden.

MARINETTE, WIS.—The Michigan Telephone Company intends to build a private telephone line from Holmes logging road. The line will be 5 miles in length and will extend between their camps near Pembine.

PUEBLO, COL.—It is reported that the Colorado Telephone Company will construct a telephone exchange on D Street, between Union Avenue and Victoria Avenue. The new structure, with apparatus, will cost, it is estimated, about $16,000.

JOLIET, ILL.—On August 24 the City Council granted a fifty-year telephone franchise to Colonel John Lambert. It is thought that this franchise will cause competition with the Chicago Telephone Company, which has held the field in Joliet for a number of years.

HOUMA, LA.—The work of building a telephone line which will extend from this town down Bayou Terrebonne a distance of 25 miles, and on the Bayou Grand Caillou 7 miles, has been commenced. The line will touch at all the large sugar plantations and refineries on the Bayous Terrebonne and Grand Caillou.

A NEW RECORD has been made in the rapid transmission of legal affidavits by means of the telephone. On August 30 a firm in Minneapolis, Minn., wired their correspondents in New York City that they had an attachment against the Bank of Minneapolis for $9000, and that the bank had just suspended operation. They stated that there was a balance at the National Bank of Commerce in New York City, which they wished to attach. As there was danger of the affairs of the Bank of Minneapolis being put into the hands of a receiver at any moment, in which case the account in New York would be tied up, arrangements were made to draw up an attachment in New York City by telephone from Minneapolis. The telephoned affidavits were written out at this end, and further affidavits were made by New York acquaintances of the Minneapolis gentleman talking as to the recognition of the identity of the voices over the telephone. All these papers were attested by a notary, taken into court and placed in the hands of the sheriff for service. This prompt action served its intended purpose, and like a similar action carried on between Cincinnati and New York last week, will almost certainly be indorsed by the higher courts. Such cases have previously been overthrown only through the lack of positive identification of the sender's voice.

ELECTRIC LIGHT AND POWER.

DUBLIN, GA.—Dublin has voted in favor of issuing bonds for electric lights.

GILMAN, ILL.—Messrs. George W. Pawley & Son, of Forrest, will build an electric-light plant in this place.

BALTIMORE, MD.—David M. Newbold has been appointed receiver of the Eastern Electric Company, of this city.

LANSDALE, PA.—The advisability of spending $20,000 for a municipal electric light plant for this town is being considered.

SACRAMENTO, CAL.—The question of issuing $60,000 for an electric light plant, to be owned by the city, is being discussed here.

FREEPORT, L. I.—An election will be held here September 7 to vote upon the proposition of expending $20,000 for an electric light plant.

SOUTH ORANGE, N. J.—The People's Electric Light & Power Company, of Newark, has been awarded the contract for lighting the streets of this city.

CAREY, OHIO.—The village of Carey has let the contract for the construction of an electric-light plant to three separate bidders, the whole amounting to $9200.

PAULDING, OHIO.—A company has organized and been incorporated in this place with a capital stock of $10,000, for the purpose of erecting an electric lighting plant.

CINCINNATI, OHIO.—The Edison Electric Company has decided to build a new plant in this city, and bids have been asked for for the necessary material and machinery.

TUNKHANNOCK, PA.—The Tunkhannock Electric Light, Heat & Power Company has been granted a franchise, and it is expected that the plant will be in operation by December 1.

WEST BAY CITY, MICH.—Judge Maxwell dissolved the injunction restraining the Mayor and Recorder from issuing bonds to the amount of $20,000 for the erection of an electric light plant, to be owned by the city.

BEEVILLE, TEX.—Electric light is to be introduced into this place. Messrs. J. S. Sale and Victor H. Koos, of Waco, are working up interest in the system and will put in new machinery and have the lights in operation by the end of September.

PORTSMOUTH, OHIO.—The Portsmouth Street Railway & Light Company is receiving prices for one new railway generator, one new 2000-volt alternating-current incandescent light machine, and two 50-light arc machines. The company expects to contract for this apparatus not later than September 15 next.

ST. LOUIS, MO.—The Edison Electric Illuminating Company has defaulted in the payment in interest on a $4,000,000 mortgage on its property, and the plant is to be sold under foreclosure proceedings on September 11. The holders of 3977 shares have signed an agreement for the reorganization of the company on a plan favored by the Street Railroad & Illuminating Properties Company, of Boston, the largest stockholder.

The Electric Railway.

PUEBLO, COL.—A 2-mile trolley line is to be built soon between Pueblo and River View Cemetery.

BANGOR, ME.—Work has been commenced on the extension of the Bangor & Winterport trolley line.

MONONGAHELA, PA.—The Union Traction Company proposes to extend its line to Dravosburg and Elizabeth.

GREAT NECK, L. I.—It is proposed to extend the Great Neck branch of the Long Island Railroad to Port Washington.

CINCINNATI, OHIO.—The Cincinnati Street Railway Company has decided to make several extensions of its street railway lines.

WESTBROOK, ME.—The Westbrook, Windham & Harris Electric Railway Company proposes to construct a railroad in this city.

TAUNTON, MASS.—A project is on foot to build an electric road to connect this place with the Eastons, Mansfield, Norton and Attleboro.

BOONE, IA.—Work on the electric street railway in this place has been commenced, and it is thought it will be completed within sixty days.

HILLSBORO, WIS.—The residents of this place have raised a bonus of $15,000 for the construction of an electric line between this place and Union Centre.

SOUTH FRAMINGHAM, MASS.—The Framingham Union Street Railway Company is considering the equipment of its Saxonville division with electric power.

DETROIT, MICH.—Work on the Detroit, Lake Shore & Mt. Clemens Railway has been begun, and it is expected that it will be completed within four months.

OLEAN, N. Y.—The Olean Terminal Railway Company has been incorporated for the purpose of building an extension to the Olean and Bradford trolley line.

TAMPA, FLA.—After a hard fight the City Council has passed an ordinance granting a franchise to F. A. Salomonson and others, to build a street railway from Tampa to Ybor City.

ST. JOHNSBURY, VT.—The St. Johnsbury Electric Street Railway Company proposes to extend its line to Lyndonville. A committee has been appointed to estimate the cost of building the same.

ROCHESTER, N. Y.—The Olean Terminal Railway Company has been granted a franchise for an electric line in this city. The Olean Street Railway Company will also petition the city for a franchise.

McKEESPORT, PA.—The Versailles Traction Company, which operates between this place and Boston Bridge, has been sold to a syndicate, which proposes to build a road from McKeesport to West Newton.

LOS ANGELES, CAL.—Andrew McNally and D. B. Dewey, of Chicago, are interested in the Los Angeles and Pasadena road, which is about to be constructed between those two points. The estimated cost is $1,000,000.

CLEVELAND, OHIO.—The Cleveland & Lorain Electric Railway Company has just completed the construction of between 17 and 18 miles of electric railway, and it is expected that the road will be in operation about the end of September.

SAN FRANCISCO, CAL.—The Market Street Railway Company has surveyors at work on the route of the Park & Ocean steam road, with the view to the changing of this line into an electric road. It is expected that active operations will commence in a short time.

GAINESVILLE, GA.—There is a movement on foot to build a new street railway here. Mr. J. M. Oliver is at the head of the movement and the stock company has made an application for a charter. If the charter is granted the road will be started at once, and 20 miles will be laid down.

STOWE, PA.—The citizens of Chartiers, Stowe, Robinson, Moon, North Fayette and Findley Townships, are circulating petitions to be presented to the County Commissioners for a highway to traverse their respective localities. The proposed road will be 16 miles long, and, if built, will cost between $75,000 and $80,000.

ALBANY, N. Y.—The State Board of Railroad Commissioners has approved the application of the Ocean Electric Railway Company to construct a surface road to Far Rockaway. A condition of the application is that the road shall not cross the Long Island Railroad at grade at Hollywood and Carnaga Avenues.

ASBURY PARK, N. J.—The Atlantic Coast Electric Railroad Company, which controls all the trolley roads on the Jersey coast from Pleasure Bay on the north to Belmar on the south, has acquired the entire frontage and all the desirable building sites from Elberon to Deal Beach, which includes about 40 miles of avenue, road, street and ocean frontage.

SPRINGFIELD, MASS.—A continuous trolley line is projected for the west side of the Connecticut River, connecting the cities of Springfield and Hartford. The officers and engineers of the Southwestern Trolley Company, which has secured a charter to build a road from Springfield to Rainbow, have been looking over the survey, and it is expected that work will be commenced shortly.

Legal Note.

ON AUGUST 25, Judge Putnam, of the United States Circuit Court for the District of Massachusetts, rendered a decision in favor of the complainant, with an order for an injunction and accounting, in the suit of the Consolidated Car Heating Company, of Albany, N. Y., against the American Electric Heating Corporation and the West End Street Railway Company, of Boston, Mass. This is the suit for the infringement of the patent to James F. McElroy, covering the Consolidated Car Heating Company's spiral coil construction of electric heaters.

Personal Notes.

MR. SETH C. ADAMS, formerly secretary and treasurer of the Bossert Electric Construction Company, Utica, N. Y., has severed his connection with that concern.

MR. A. B. FIELD, formerly representing the Anchor Electric Company, of Boston, now represents the Perkins Electric Switch Manufacturing Company in the States of New York and Pennsylvania.

MR. H. B. CULBERTSON, of the Westinghouse Machine Company, Pittsburg, has been spending part of his vacation in that well-known summer resort, New York. Mr. Culbertson feels very much encouraged over the business outlook, and is particularly gratified over the sales made of the new Westinghouse gas engine.

MR. WILLIAM R. GOODMAN, manager of the Chicago Fuse Wire & Manufacturing Company, is in New York, on his way back to Chicago from a business trip. He reports business in a most satisfactory condition. The company now carries stock at its New York agency, 852 Broadway, and is prepared to fill Eastern orders promptly.

MARRIED.—In Fremont, Ohio, on September 1, Miss Fannie Hayes, daughter of former President Rutherford B. Hayes, and sister of Mr. Webb C. Hayes, secretary of the National Carbon Company, Cleveland, Ohio, was married to Ensign Harry Eaton Smith, U. S. N. A special train from Cleveland brought President and Mrs. McKinley and others to the ceremony.

Trade and Industrial Notes.

MR. G. G. LUTHY, of the Royal Electric Company, of Peoria, Ill., was on a visit to Chicago last week. He says the tide of prosperity has at last made itself felt in his section of the country, and that his company is as usual getting a good share of the business.

MR. H. J. GILLE, Northwestern representative for the Washburn & Moen Manufacturing Company, with headquarters at St. Paul, Minn., made a visit to Chicago last week. He reports such an improvement in business in his section of the country that the change is almost incredible.

MR. RICHARD O'CONNOR, of the Globe Carbon Company, Ravenna, Ohio, has just been appointed the Eastern representative of the National Carbon Company, of Cleveland, with headquarters at New York. Mr. O'Connor is a great favorite with the trade, and his many friends wish him every success in his new field.

THE NEW CARBON BATTERY of the Phoenix Carbon Manufacturing Company, of St. Louis, merits the careful attention of all battery users. Such an extremely large surface of both carbon and zinc is exposed to the acid in the battery that it stands remarkably large overloads and does not polarize even on closed circuit work.

THE WARREN ELECTRIC & SPECIALTY COMPANY, of Warren, Ohio, reports that it has secured the contract for furnishing the new Public Library in Chicago with 10,000 of its high-efficiency lamps. The company states that its business is in excellent condition and that it is in a position to fill all orders promptly.

MR. M. T. DAVIDSON, of New York, has received the order for and is now building a large horizontal, triple-expansion pumping engine for the Mt. Prospect pumping station, Brooklyn, N. Y. Mr. Davidson is also to furnish the pumping engine for the new Arbuckle Bros.' sugar refinery, now in the course of erection in the City of Brooklyn.

THREE WILLIAMS ENGINES, one of 1500 horse-power, and the others of 750 horse-power each, have been placed by William Tod & Co., Youngstown, Ohio, in the new station of the Edison Company, in New Orleans. The engines are vertical, triple-expansion, three-crank, and are direct connected to Edison generators for three-wire lighting.

THE ENCLOSED ARC LAMPS of the Electric Arc Light Company, of New York City, have obtained favor in some more large installations. Orders have been received by the company for 135 lamps for the new plant of James A. Hearn & Sons, Fourteenth Street, New York, and for seventy-six lamps for the Callender, McAuslin & Troup Company, Providence, R. I.

MR. A. SHILLINGLAW, Western representative for the M. C. Bullock Manufacturing Company, of Cincinnati, Ohio, has made the following sale to Armour & Co.'s Omaha stock yards: Two 200-kw generators and one 150-kw generator. He has also sold one direct-connected motor to the *Evening Journal*, of Chicago, and has also closed a number of smaller deals during the past week.

A NEW INCORPORATION.—The business formerly handled by the firm of H. M. Shaw & Co., New York City, is now managed by an incorporation under the same name. The capital stock of the new company is $10,000. The change was rendered necessary by the increasing volume of the business of manufacturing woven wire gauze, copper leaf and fingered dynamo and motor brushes.

THE LITTLE HUSTLER MOTOR, which has been built for battery fan purposes by the Knapp Electric & Novelty Company, New York City, has created a demand for itself for use as a toy and in demonstration of motor design. Now that the fan season is closed the motor will be sold in parts ready for assembling. For "teaching the young idea how to shoot" this should prove a good investment.

THE BALL ENGINE COMPANY, Erie, Pa., states: "The J. S. Menken Company, Memphis, Tenn., in a letter to us ordering a crank-pin box for a 60-hp engine, say that this is the first repair part ordered since the installation of the engine ten years ago. This substantiates our claim, which we can verify by other instances, that a well-built high-speed engine has as long a life, with greater freedom from repairs than a slow-speed engine."

A STEEL BATTERY CELL, enameled inside and out, is the latest improvement put out by the Gordon-Burnham Battery Company, 82 West Broadway, New York City. The cell is intended for positions where it will be ex-

posed to jars and blows, as in gas engine rooms or on shipboard, etc. The new cell is extremely handy in transportation also, as it will stand all the abuse that a good football could be expected to take.

A NEW CATALOGUE has been issued by Stanley & Patterson, 32-34 Frankfort Street, New York. This catalogue covers their supplies for electric bell, telegraph and telephone work, apparatus for heavy work being separately listed in other catalogues. The new catalogue is complete, and is thoroughly indexed. Besides the alphabetical index there is a number index, which saves time and trouble in looking up numbered orders.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison Street, Chicago, has issued a new and very comprehensive catalogue of over 500 pages. The new book, which is called Catalogue No. 12, has listed within its covers supplies for electric light and power, electric railways, telephone and telegraph systems and all sorts of electrical house goods. The work is thoroughly and beautifully illustrated. Accompanying the catalogue is a complimentary order book arranged for duplicate orders and with carbon paper and colored blanks complete.

THE UPTON LONG-BURNING MIDGET LAMP in its original form, adapted to burn singly on 110 volts, has proved to be such a success that several modifications of it have been designed, including the Midget long-burning lamp to burn two in series on 220 volts, a Midget lamp to burn five in series on 500 to 550 volts, and a Midget high-tension series lamp to burn on series arc circuits of from 4½ to 7 amperes. All of these lamps are giving remarkable results, and having a very large sale. The Midget Upton lamp is one of the Electric Appliance Company's specialties, and it is pushing the lamp with its usual energy.

WALTER C. McKINLOCK, 1108 Fort Dearborn Building, Chicago, Ill., is handling the products of the Merritt Electric Company. The latter is a manufacturer of lamp refillers, and can refill any lamp in a manner that makes it impossible to distinguish it from a new one. A new lamp is practically made from a burnt-out one, and as a new and superior filament and new vacuum and clean bulb are the only essential things, there is no good reason why every lamp should not be renewed. This factory that Mr. McKinlock represents, has a capacity of 25,000 lamps per day. On any order for lamps they can be refilled and returned within three days.

THE BELKNAP MOTOR COMPANY, Portland, Me., is doing an immense business in the sale of Chapman voltage regulators, which have been indorsed by many people who are interested in new devices and developments in the electrical line. They are used extensively in connection with water wheels where there is no governor, none being necessary, as the voltage can be kept constant with a variation in speed ranging anywhere from 2 to 50 per cent. They are also found very valuable in connection with engines with large changes of load, voltage being kept constant. The following orders have recently been received: Marietta Electric Company, Marietta, Ohio; Union Electric Company, Manchester, N. H.; Mousam River Railway Company, Sanford, Me.; Potomac Electric Company, Washington, D. C.; D. E. Stearns, Skyuka, N. C.; Electrical Engineering Company, San Francisco, Cal.; United States Electric Lighting Company, Washington, D. C.; Knoxville Electric Light & Power Company, Knoxville, Tenn.; Redwood Roller Mills, Redwood Falls, Minn.; St. Croix Gas Light Company, Calais, Me.; Wilmington Street Railway Company, Wilmington, N. C.; Calumet & Hecla Smelting Company, South Lake Linden, Mich.; F. Mercier & Son, Princeton, Me.

A NEW TIPLESS LAMP has been constructed by the Fort Wayne Lamp Company, and put on the New York market by G. Humbrocle, manufacturer's agent, 39 Cortlandt Street, New York City. The lamp is peculiar in having the filament loosely anchored to the end of a long thin glass rod, which extends out from the base of the lamp quite to the filament. The mounting of the filament terminals is also peculiar. They are spread quite wide apart, starting from little glass tips mounted on the sides of the bulb. Mr. Humbrock reports a remarkable revival in business activity. He has recently received orders for 5000 lamps for the New York Post Office, has contracted for the complete lighting system for the police stations and headquarters in Jersey City, for all the supplies to be used in the distribution system of the Capitol at Albany, and also in the Samaritan Hospital, Troy, and the large church at Ballston Spa. Benton, Heath & Co.'s paper mill, in Hoboken, is also to be fitted out with an electric lighting system by the same firm, and the publishing house of A. Datz, in Jersey City, is to have a complete lighting and power distribution system and isolated plant installed. The same firm has also a contract with R. H. Macy & Co., for their new building on Fourteenth Street.

ALTERNATING-CURRENT MEASURING INSTRUMENTS are rapidly being perfected and brought up to the high standard long attained by direct-current instruments. A new and complete set of instruments has been put on the market by the Wagner Electric Manufacturing Company, of St. Louis. The instrument faces resemble somewhat the familiar edgewise type, except that the dial is horizontal instead of vertical. The movement of the indicator is dead beat, and the scale is expanded when desired at the normal load point. Provision has been made for illumination of the scales from behind, the scales themselves being drawn on highly glazed opal glass. The instruments are made up as voltmeters, ammeters and wattmeters. The Wagner Company has also put out a new list and description of its well-known transformers. The description is quite interesting, as it gives complete accounts of accurately made tests. Another new publication of the Wagner Company is the pamphlet describing and listing its high-grade switches. These switches are made up in all desired forms, single-pole, double-pole, single and double throw, multiple blades, complete panel boards, outdoor pole line switches, etc. A complete telegraph code of all the different sizes and types is carried through the pamphlet, permitting orders to be rapidly placed at the minimum expense.

THE C & C ELECTRIC COMPANY, New York, has just secured, through its Mr. Campbell Scott, a contract for what is to be one of the largest isolated electric power transmission systems in any of the mills in this country. This installation is for the silk mills at Petersburg, Va., owned by Messrs. John N. Stearns & Co., who also operate large mills at Williamsport, Pa., and in New York City. The Petersburg buildings are very much scattered on either side of the Appomatox River, which stream supplies power to the mills from three turbines of 415-hp capacity. Their present power transmission system involves the use of long lines of heavy shafting, rapid drives, large and long belts, and a vast array of beveled gears. It is estimated that their present loss in transmission exceeds 45 per cent. between the turbines and their line shafts. Through the electric transmission system, which the C & C Electric Company will install, it is expected to cut their loss down to within 15 per cent., and at the same time have a system of the greatest flexibility and of wonderful simplicity of control. The installation will comprise two 100-kw and one 125-kw C & C M. P. generators of their latest type, which will be driven by belts from the turbines. The machinery in each of the different rooms of the several buildings will be driven by an independent motor, either of the C & C M. P. slow-speed, or the closed, iron-clad types. The motor installation will have a total capacity of 315 horse-power, and will consist of the following units: Three 50 horse-power, one 45 horse-power, one 40 horse-power, one 25 horse-power, one 18 horse-power, one 16 horse-power, one 15 horse-power, one 6 horse-power, and one 3 horse-power.

A NEW IRON CONDUIT for interior wiring has been put on the market by the American Circular Loom Company, of Boston, Mass., selling agent for the manufacturer, the Boston Electroduct Company. The new conduit differs from its predecessors in one marked respect. It is neither exactly a lined pipe nor a plain pipe. In the course of manufacture the pipe is immersed in a composition, which is afterward baked on its surface, both interior and exterior. The composition is somewhat thicker than japanning and thinner than enamel. It is very strongly adhesive and possesses quite a high polish, the tube resembling closely the tubing of a bicycle frame. It is very difficult to crack or break this covering, and the conduit may be readily bent to any radius around which a wire can be pulled without injuring the covering whatever. While the covering is not depended upon for insulation, yet it has a remarkably high insulation resistance. The advantages of such a covering are that it renders the pipe absolutely free from rusting or corrosive influences, gives a smooth polish, which appears well on the exterior surface in exposed work, and renders the wire very easy to draw in. The covering is free from the disadvantage of filling up part of the pipe. A given conduit with a thin lining of this nature will, of course, have a far greater capacity than the same conduit with a thick lining; or, looking at the matter from another standpoint, a given conductor can be covered with a smaller conduit of this type than it could be with a thickly lined conduit. The name "Electroduct" has been registered by the Boston Electroduct Company, whose factory is at McKeesport, Pa., adjoining the grounds of the National Tube Works.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

VISITORS TO LINCOLN PARK IN CHICAGO will be delighted with the souvenir book of this beautiful spot, now being distributed by the Chicago, Milwaukee & St. Paul Railway Company. It is a magnificent publication of 96 pages, full to overflowing with delicious half-tone pictures of one of Creation's most charming places of resort for citizens of the great republic. No stranger visiting Chicago should be without a copy of the "Souvenir of Lincoln Park." It can only be procured by enclosing twenty-five (25) cents, in coin or postage stamps, to Geo. H. Heafford, general passenger agent, 410 Old Colony Building, Chicago, Ill.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 17, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

588,591 ELECTRIC BATTERY; W. Mills, Elizabeth, N. J. App. filed Nov. 30, 1896. The combination in a battery, of a containing cell, a cover therefor, an annular zinc element, an insulating bushing detachably secured to the edge of said element, and a conducting rod secured to said element below the bushing and passing upwardly and outwardly through said bushing.

588,592. ELECTRIC BATTERY; W. Mills, Elizabeth, N. J. App. filed Nov. 30, 1896. The combination of a cell, a cover, an element depending from said cover, a plate surrounding said element, an upwardly extending rod secured to said plate, an apertured insulating bushing passing through said cover, a recess formed in said bushing opening into said aperture, a groove likewise formed in said bushing and passing entirely therethrough, a boss on the exterior of the bushing engaging a seated recess formed in the cover, and a stud extending from said rod for co-operation with either the recess or groove in the bushing.

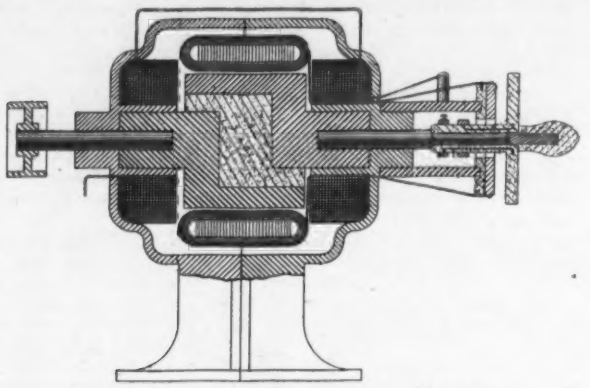
588,602. DYNAMO-ELECTRIC MACHINE; L. C. Rice, St. Louis, Mo. App. filed Nov. 4, 1896. In a dynamo electric machine or motor, a stationary armature, a stationary field magnet or magnets, a rotating inductor magnet having poles of opposite polarity magnetically insulated from each other and a casing completely inclosing said armature, a field magnet or magnets and inductor magnet, and forming part of the magnetic circuit.

588,610. ELECTRIC ARC LAMP; T. Spencer, Philadelphia, Pa. App. filed

Nov. 16, 1896. In combination, in an enclosed arc lamp adapted to be operated by an alternating current, opposed solid carbon electrodes, an inclosure for the proximal ends of said electrodes, a choking coil in electric circuit with said electrodes, an automatically movable core for said choking coil, and means connective of said core and one of said electrodes whereby a reciprocatory movement of said core may be imparted to said electrode.

588,666. MEANS FOR SUPPORTING ROTATING SHAFTS; W. Stanley and F. Darlington, Pittsfield, Mass. App. filed May 5, 1897. The combination of a rotatable shaft of magnetic material and a magnetic system producing a magnetic flux symmetrical thereto and in supporting relation thereto.

588,669. ELECTRIC WICK-LIGHTING DEVICE; H. Van Hoevenbergh, New York, N. Y. App. filed May 5, 1896. The combination with a central



No. 588,602.—DYNAMO ELECTRIC MACHINE.

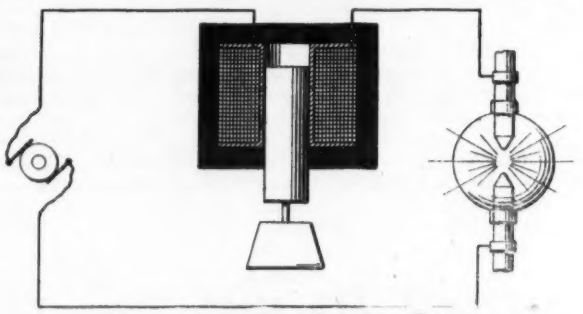
draft lamp of a high resistance conductor to the upper end of the wick tube, an auxiliary wick or oil-absorber adjacent to such conductor, and an electric circuit in which the conductor is located.

588,670. COUNTING AND SIGNALING APPARATUS; B. E. Waters, Brockton, Mass. App. filed Feb. 8, 1897. A counting and signaling apparatus made up of three discs, a jointed lever made up of two arms, a spring fast to one arm of the jointed lever and passing by said joint, a pawl on one of the arms engaging with a ratchet fast to one of the discs; an insulated electrode, a spring electrode normally in contact with the other electrode and a finger on one of said arms, all arranged to cause the movement of the jointed lever to first operate the counting mechanism and then to operate the signaling mechanism by the further movement of the arm.

588,683. ELECTRIC-LIGHTING SYSTEM; F. W. Lord, Boston, Mass. App. filed June 19, 1897. The combination in an electric-lighting system of a two-way switch and a two-way lamp socket connected at two corresponding points, and connections from the third point on the socket and on the switch to the mains of the system.

588,686. ELECTRIC CUT-OUT; N. Marshall, Boston, Mass. App. filed May 29, 1896. The method of interrupting electric arcs formed between two circuit terminals normally connected by fusible material which consists in creating a substantially large gaseous or air pressure by the heat generated by the melting of the said fusible material and consequent formation of the arc, and causing the same to pass in a smaller or restricted amount across the plane or path of the arc formed between the said terminals at a different point from that at which the pressure is created.

588,692. ARMATURE FOR INDUCTION MOTORS; A. L. Cushman, Concord, N. H. App. filed Aug. 15, 1894. In an armature for induction motors, a core having a short-circuiting ring at one end and short-circuiting ring segments at the other, and two or more interiorly connected plates insulated from each other, a series of energizing coils externally arranged upon said core, one end of each coil connected to said plates and the opposite end closed on the short-circuiting ring, spring-actuated levers pivoted within



No. 588,610.—ELECTRIC ARC LAMP.

said core and provided with plates insulated from each other and adapted for contact with those of the core, and coils provided within said core and composed of separate insulated wires of varying degrees of resistance, one end of said interior coil being attached to the plates of said core and the other to the plates of said levers.

588,695. ELECTRIC BURGLAR ALARM; H. M. Dumas, Detroit, Mich. App. filed Aug. 24, 1896. In a burglar alarm, the combination with a normally closed main circuit passing from the central office to the guarded building, a normally open shunt circuit in the guarded building, guard switches adapted when operated to close the main circuit through the shunt and an automatic signaling instrument in the shunt, of an automatic switch in said shunt adapted to be operated by the closing of said shunt and adapted after being so operated to maintain the shunt permanently closed.

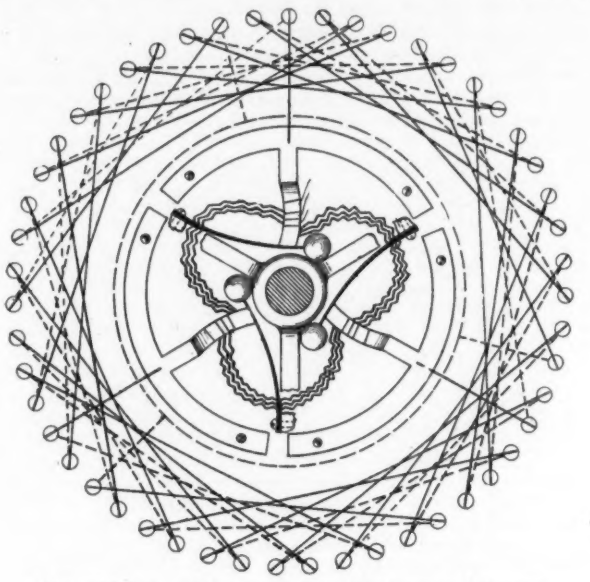
588,701. STATION INDICATOR FOR TRAMWAY OR OTHER CARS; H. W. Langschmidt, Brooklyn, and R. F. LeBrocq, New York, N. Y. App. filed Oct. 16, 1896. In combination, the casing, main and guide rollers, a spring-operated gearing, a fly driven from said gearing, a double-armed detent having one arm in proximity to the fly and the other arm riding upon the periphery of one of the rollers and adapted to enter a recess therein to permit the other arm to engage the fly, the armature having connections for moving said detent to release the fly, an electromagnet with electrical connections thereto and means for preventing immediate return of the detent to normal position.

588,771. ELECTRIC CONNECTION BETWEEN RAILWAY RAILS; F. Marsellis, Peralta, Cal. App. filed May 13, 1897. A device for electrically connecting the ends of railway rails, consisting of curved segmental conducting plates adapted to span the space between the rails and having their opposite ends bent or curved to one side to form contact with the rail webs, and superposed fish plates with holding bolts whereby the conducting plates are forced into contact with the rail webs.

588,791. ELECTRIC RAIL BOND; W. B. Cleveland, Cleveland, Ohio. App. filed April 15, 1897. An electric rail bond consisting of an oblong frame formed from a laterally compressed coil of flat wire coiled to have its flat sides bearing against each other, and of terminal heads and legs cast upon the doubled ends of sad frame.

588,797. ELECTRICAL KEG REGISTER; W. Kraft, Baltimore, Md. App. filed June 1, 1897. In an apparatus for registering kegs as they are removed from the cellar by means of an elevator, the combination of a lever which is moved by the kegs as they ascend, a roller carried thereby, plates in electric circuits across which the roller is adapted to pass, electrically operated registers in the circuit of said plates, and a ginger pivoted in the lever to normally keep the circuit open and which as the kegs pass it is deflected to close the circuit and operate the register.

588,822. ELECTRIC ARC LAMP; B. F. Greene, Sheridan, Pa. App. filed April 22, 1897. In an arc lamp the combination with a clutching ring of a sleeve having a mitred end engaging said clutching ring and a swinging frame carrying an elbow lever to engage the ring, said swinging frame con-



No. 588,692.—ARMATURE FOR INDUCTION MOTORS.

nected to an armature and dash pot to operate the clutching ring and automatically feed the carbon as required.

588,831. ELECTRICAL TRANSMISSION OF POWER; E. Lanhoffer, Mulhausen, Germany. App. filed June 20, 1895. A system of electrical transmission of power, provided with a regulating device for the armature comprising a plurality of circuits whose potentials are to each other approximately as the terms of a geometric progression, in combination with another regulating device operatively connected to the one first named, and comprising a plurality of resistances arranged in series, said resistances controlling the intensity of the field, whereby the variation of the field intensity will be approximately the same for all differences of potentials.

588,880. ELECTRICAL INDICATOR FOR VALVES; W. J. Rickard, Philadelphia, Pa. App. filed Oct. 31, 1896. In an electrical indicating apparatus, a main conduit, a valve chamber connected therewith outside of the direct line of flow of fluid in said conduit, a nozzle having a cock connected with the conduit, a normally open electric conduit provided with an alarm, and a circuit closer therein in the outlet of said valve chamber controlling said alarm

588,890. INCANDESCENT ELECTRIC LAMP SUPPORT; E. L. P. Wetmore, Marquette, Mich. App. filed March 13, 1896. The combination with suspended metal tracks and circuit wires connected thereto, of a carriage movable on said tracks comprising a non-conducting body having a series of holes or openings therein, metallic side plates, screws holding the same to said body, nuts on said screws, located in said holes or openings, wheels connected to said sides and engaging said tracks, the plates on said body in electric connected with said side plates, a lamp, and flexible wires thereof connected to said plates.

588,905. ACTIVE MATERIAL FOR ELECTRODES OF ELECTRIC ACCUMULATORS; S. Hammacher, Berlin, Germany. App. filed Aug. 28, 1896. An active material containing a compound of lead oxide and a member of the pyridine series.